SYNTHESIS OF 2013 RIVER RECREATION STUDIES

KING COUNTY RIVER RECREATION STUDY

King County

Department of Natural Resources and Parks

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KING COUNTY RIVER RECREATION STUDY

Prepared for

King County

Department of Natural Resources and Parks
Water and Land Resources Division
201 South Jackson Street
Seattle, Washington 98104-3855

by

Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206/441-9080

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INTRODUCTION

Background

Recreation use of urban rivers is a rarely studied, yet critical component of effective multi-objective river and floodplain management.

A century of attempts to tame local rivers by drying out floodplains, straightening channels, and, in places, literally re-plumbing entire systems seems to have resulted in a cultural expectation held by some recreationalists that rivers should be predictable and even safe. However, river channels, whether highly modified or more natural in form and function, pose significant risks to poorly prepared and unskilled users, particularly when flows are high or water temperatures are low. Contemporary flood-risk-reduction and habitat-enhancement goals call for capital projects that foster a more natural river environment. Projects are designed to be self-mitigating for their natural resource impacts, and, where possible, to achieve a net gain for multiple objectives.

By their nature, smaller levee and revetment repair and reconstruction projects and other bank stabilization projects modify river banks. To enhance fish habitat, these projects typically include installation of natural materials, such as large wood, as key project features. These projects introduce elements that increase local habitat diversity, but are inherently more hazardous for river users than the rock riprap traditionally used for bank stabilization. Larger projects involve reconnecting historical floodplains and setting back levees to improve flood storage and conveyance by allowing rivers room to naturally migrate across their floodplains and to naturally recruit and distribute wood and sediment. As a result of many flood-risk reduction and salmon recovery projects in King County, the county's rivers may become more dynamic and less predictable. All of these changes can alter recreational users' experience of the river environment as they boat, float, or swim. While King County is not responsible for individual decisions by river recreationalist, the County is interested in where and when recreational use takes place, and how users interact with the river.

Purpose

King County's river managers view a better understanding of the recreational users of rivers, and those users' perceived risks, as a critical component in effective and sustainable floodplain management that addresses the needs of fish and wildlife. Understanding recreational use on rivers allows for the appropriate consideration of recreational user behavior, timing, and associated risks in project conceptualization, design, effectiveness monitoring, and adaptive management.

King County conducted several studies in the past 5 years to gain information on recreational use of its rivers. In 2009, King County commissioned a report (MacIlroy 2009) that compiled interviews and surveys of knowledgeable individuals and organizations, and provided a reach-by-reach characterization of river recreation in the county. A 2010 pilot study of recreational

use specifically on the Cedar River (Biedenweg and Akyuz 2011) used intensive observational study and in-person interviews to identify patterns of recreational use, as well as attitudes and awareness regarding river safety. Although that pilot study provided valuable information, it was uncertain whether the methods and cost would be appropriate for every reach of every county river.

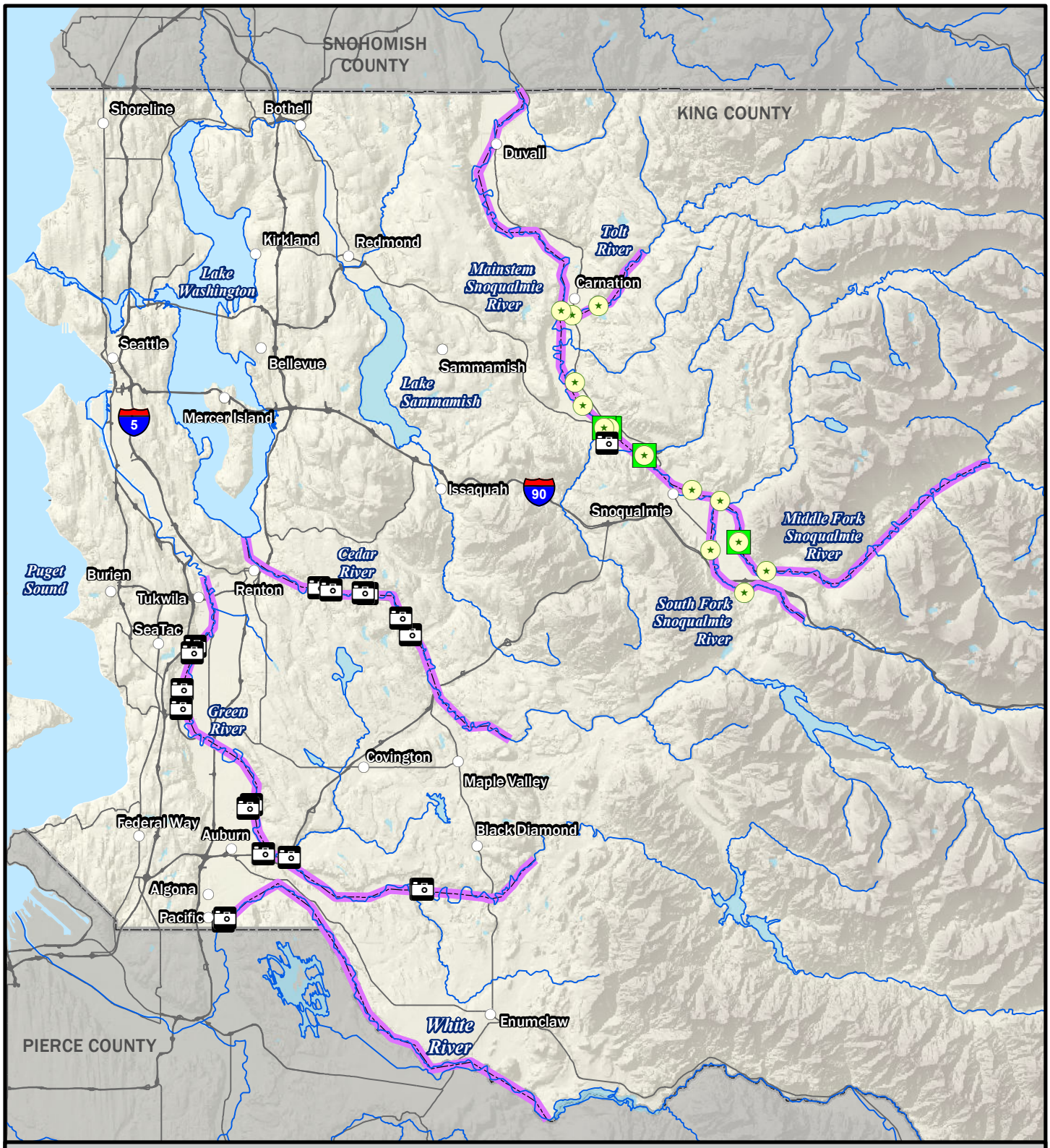
In addition to these formal studies, King County, through the various day-to-day activities that it carries out, has obtained additional anecdotal information that contributes to river managers' overall understanding of recreational use. For example, the King County Sheriff has observed that river recreational use shifts within and among basins in response to conditions, including construction. This was most evident when the Tolt River Levee Setback Project was being built and recreational use on the lower Tolt dropped significantly, while simultaneously the Fall City reach experienced a significant increase in use (K. Vanderpool, personal communication 2013).

Those prior studies, and work the County completed with the Large Wood Stakeholders Committee in 2009, clearly indicate that there are two categories of river users in King County. The first category includes "professional" river users—including fishing, guiding businesses, or expert kayakers and canoeists—who are generally well prepared for the river, aware of inherent dangers, and adept at maneuvering their vessels to avoid hazards. The second category of river users includes "casual" recreationists who tend to float the river a few times a year, are unfamiliar with how to read the river, are generally less prepared, and who use vessels that lack maneuverability. While King County cannot be responsible for individual decisions related to recreational river usage, the County wants to better understand this second group.

The study described in this report builds upon these previous studies. Intensive study methods used on the Cedar River in 2010 were repeated in the Snoqualmie basin where recreational use is known to be heavy. In addition, the study tested other data collection methodologies, looking for less staff-intensive ways to understand and monitor recreational use on King County rivers. This report describes the methods, results, and comparative analysis. The recreational use data from the current and previous studies will be used in the development of multi-objective plans on King County rivers. The data will inform the development and implementation of capital projects, including physical design, construction timing, mitigating actions, and performance monitoring, and will also inform the management of the project and the associated project reach over time.

Study Area

The overall study area encompassed the mainstems of the Snoqualmie, Cedar, Green, and White Rivers within King County, as well as the lower portions of three major tributaries of the Snoqualmie River: the Tolt, Middle Fork, and South Fork. These study reaches were chosen for their proximity to future major capital investment river and floodplain management work. Figure 1 shows the overall study area and where various methodologies (which are described below) were employed.



Legend

- Remote camera location
- Interview location
- Field observation site
- Aerial survey flight path

Figure 1. 2013 River Recreation Study Area.

N

0 5 10 20 mi

King County

Aerial: USDA (2013)
Prepared for King County by Herrera

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Study Period

The study period extended from June 22, 2013, when the first field observations at locations in the Snoqualmie River basin were conducted, to September 17, 2013, the date of the last download of remote camera data.

Previous Studies

MacIlroy Study (MacIlroy 2009)

In May and June of 2009, Carol MacIlroy Consulting Corporation conducted surveys and research to "describe the spatial and temporal use of King County's rivers by recreational activity" (MacIlroy 2009). The study focused on the five major basins in the county: those of the Skykomish, Snoqualmie, Cedar, Green, and White Rivers. The study authors sent a written survey to more than 40 individuals who typically were associated with appropriate organizations or were otherwise identified because of their expertise or experience. Some of the survey recipients forwarded the survey onto other individuals. A total of 29 completed surveys were returned to the study authors. In addition, the study authors conducted in-person interviews and one telephone interview.

The study reached several key findings that are relevant to this current (2013) study:

- Ambient air temperature affects the level of use by swimmers, inner tubers, and recreational floaters, and is the primary reason that the highest overall recreation use occurs during summer months.
- River flow levels affect the level of use by paddlers and fishers. Many survey respondents expressed the concern that the combination of high air temperatures and high flows created a high-risk situation for casual recreationists, such as inner tubers, many of whom are unfamiliar with the risks associated with high flows, especially those that occur early in the season when water temperatures are comparatively low.
- Access, including travel time and travel ease from the recreationist's point of origin, availability and proximity of parking at or near the access point, effects of land ownership on river access, and access fees, is a significant determinant of use levels.
- Additional determinants of levels of use include distance between access points and river flow velocity, which determine trip duration, and the quality of the resource, including views and the extent of human activity and features.

Based on the survey and interview data, the study authors established a four-tier ranking of the county's major rivers according to use levels. The study authors concluded that the use levels obtained from their survey and interviews probably underrepresented "highly localized recreational use" and that "[l]ocalized, on-the-ground surveys or other intensive research methods would help to improve the overall characterization of recreational use."

Based on the survey and interview data, the study authors also categorized river recreationists into three groups: safety advocates, planned use, and spontaneous use. The largest group by numbers is the spontaneous group, many of whose members may be less

well-informed than other users and who could be referred to as "casual" recreationists. The study authors pointed out that their study, because it mostly obtained data from "non-casual" recreationists, probably underrepresented the use characteristics and perspectives of this group of casual recreationists.

The MacIlroy (2009) study also reached a series of detailed findings specific to each of the rivers and reaches within the county's five major basins.

Lastly, the 2009 study included recommendations regarding future research, survey, and outreach; integration of recreation data into the County's GIS database; and potential partnerships and opportunities. This current (2013) study is one of the outgrowths of those recommendations.

Cedar River Recreation Study (Biedenweg and Akyuz 2011)

Between May and September of 2010, Kelly Biedenweg and Kate Akyuz conducted riverside observations and interviews, and used an infrared counter to collect data on recreational use on the Cedar River. Riverside observations were conducted between the hours of 11:00 a.m. and 7:00 p.m. on 52 days between May 17 and September 5. Data collected included the same characteristics and metrics collected through field observations for the current (2013) study. The methodology for the current study was based almost entirely on that used in the Cedar River Recreation Study (Biedenweg and Akyuz 2011).

Interviews were conducted with 64 individuals exiting the river and focused on where interviewees floated and why, and how interviewees interacted with and felt about large wood in the river. An infrared counter installed at a site in the lower third of the river obtained baseline counts of users during the 24 days that it was in place.

During the study, over 1,900 individuals were observed floating on the Cedar River between Landsburg Dam and Carco Park (also known as Cedar River Park) on the upstream side of Interstate 405 (I-405) in Renton. Based on a regression analysis, the total number of individuals estimated to have floated the study reach of the river during the study period was over 6,700.

The study report concludes with a series of recommendations, including recommendations for future study of recreation use on the county's rivers. In the "Survey Results and Analysis" section below, specific findings from the Cedar River Study (Biedenweg and Akyuz 2011) are compared to the findings from this 2013 study.

Cedar River Large Wood Study (2009–2011)

A river-scale field study of large wood on the Cedar River was conducted during summer months in years 2009 through 2011. Data collected included size, position, and geomorphic and habitat functions of large logs and log jams. The purpose of the study was to pilot a large wood sampling and analysis protocol for the purpose of developing large wood budgets on King County rivers. The study methods proved to be repeatable, and the data collected has provided valuable information for project planners seeking information about wood and recreation management on the Cedar River. Development of the wood budget model is in progress.

Wood pieces were classified by length and diameter and tallied into bins of like dimension. Large wood pieces that were considered to have the potential to be "key piece" size were further measured for precise length and diameter, recorded geographically using a handheld Garmin GPS device, and marked with a metal tag with a unique identification number. GPS locations and tag numbers were used to track which logs remained in each study reach after each flood season.

Large Wood and Riparian Forest Data Development Using Remote Sensing (King County RFMS/UW Remote Sensing and Geospatial Analysis Lab in Progress)

This study is developing a geospatial dataset describing the location, length, and volume of individual coarse woody debris in the Cedar, White, and Middle Fork Snoqualmie Rivers and developing a second geospatial dataset describing the location, height, crown diameter, and phylum of all trees within a 200-meter buffer of the river centerline. This work is using available datasets (LiDAR, high resolution aerial imagery, and stream and reach vector layers).

2011 Lifejacket Usage Monitoring (King County Department of Natural Resources and Parks 2012)

In 2010 and 2011, a typical La Niña winter brought turbulent winter floods that significantly changed river channels, undercut banks, relocated gravel bars, and reoriented large wood, creating many new hazards and changing known hazards. In addition, an unusually heavy snow pack in the Cascade Range river basins foretold higher and colder than usual flows in King County rivers well into the summer recreational season. These factors led the King County Executive and the King County Council to support the implementation of a temporary ordinance (Ordinance 17124) requiring that personal flotation devices (PFD) be worn in King County's major rivers from June 21 to October 31, 2011. The Temporary Ordinance included outreach to encourage life jacket usage and monitoring of life jacket usage. Monitoring protocols employed were the same as observations conducted during the 2010 Cedar River Pilot Study. Monitoring of PFD use indicated that significantly more floaters in all age groups used PFDs in 2011, subsequent to the passage of the ordinance, than were observed to use PFDs in the 2010 Cedar River Study.

METHODS

Methodologies used in the 2013 River Recreation Studies were varied. The field observation and interview methodologies that were pilot tested in the 2010 Cedar River Recreation Study were adapted and employed in 2013 in river reaches where recreational use was known or suspected to be high. In-person interviews were a value-added data acquisition method aimed at better understanding the motivations, preparation, attitudes, and awareness of users. Both observational and interview methods proved successful at collecting many user characteristics in 2010; however, they proved labor intensive. Therefore, in addition to using these methods to gather this rich data on high-use reaches, in 2013, the County tested potentially more efficient methods of data acquisition.

In areas of the county where frequency of river recreation was not known or was expected to be low, two alternative data collection methods were tried. Aerial surveys were conducted by helicopter countywide, with the expectation that video footage could capture a view of user characteristics, and that some conclusions regarding comparative use could be drawn. Remote cameras were mounted in trees, electronically storing intermittent photographic stills of the river and its use. This method was expected to catch all use during the study period, allowing data to be later analyzed in the office.

Each of these methods is discussed in this section. A summary of their application is provided below:

- **Aerial Surveys:** Comprehensive coverage along the mainstems of the Snoqualmie, Cedar, Green, and White Rivers as well as the Tolt River, Middle Fork Snoqualmie River, and South Fork Snoqualmie River; two overflights of approximately 4 hours each.
- **Remote Camera Observations:** 23 locations on the mainstems of the Snoqualmie, Cedar, Green, and White Rivers; 7 days a week for approximately 3 months at each site.
- **Field Observations:** 14 locations on the mainstem of the Snoqualmie River, Tolt River, Middle Fork Snoqualmie River, and South Fork Snoqualmie River; seven 8-hour days of observations at each location.
- **In-person Interviews:** Nine take-out locations on the mainstems of the Snoqualmie and White Rivers, Middle Fork Snoqualmie River, and South Fork Snoqualmie River; one 4-hour interview session at each of five sites, and two 4-hour interview sessions at each of four sites.

A log showing the dates of data acquisition is contained in Appendix C – Data Acquisition Log.

For each group observed, the following attributes were obtained and coded:

- Location and Observer
- Date and Time
- Total number of people
- Number of adults (age 18+), youth (12 to 17), and children (11 and under)
- Number of males and females
- Number of people wearing personal flotation devices
- Number and types of vessels
- Presence of paddles, coolers, alcohol, and fishing equipment

Specifics on the types of data collected are shown on the forms in Appendix B – Field Observation and Interview Forms.

This section also describes the methods used for coding and managing the data collected in this 2013 study and the methods used to analyze the data.

Survey

Aerial Surveys

Herrera conducted two aerial surveys that encompassed the portions of the Snoqualmie, Cedar, Green, and White Rivers within King County. Figure 2 shows the river segments covered by the aerial surveys. The goal of the aerial surveys was to obtain a near-instantaneous comprehensive snapshot of casual recreational use on the four rivers. The first aerial survey involved taking helicopter-based video footage, as well as still photographs, along each of the rivers from a height of several hundred feet. The original plan was to collect only video footage, but the availability of an extra seat on the helicopter and a volunteer photographer allowed for the collection of still photography, too. The first aerial survey was conducted on 2 days between the hours of 12:30 p.m. and 9:00 p.m.. The original intent was to complete the first survey within 1 day (July 7) between 11:00 a.m. and 7:00 p.m., but fog, navigation errors, and the slow speed of flight necessary for videotaping required the flight time to be extended to 9:00 p.m. on the first day, and the White River portion of the survey to be conducted on a second day (August 18). Videos and photographs were viewed to obtain numbers and characteristics of recreationists.

The second aerial survey used methods that were modified based on the experience from the first aerial survey. To improve the time proximity of the observations, two helicopters were employed over a 4-hour period between 2:00 p.m. and 6:00 p.m. Rather than collecting video footage, still photos were taken of each recreation group observed. The still photos were then reviewed and data on numbers and characteristics were obtained from them.

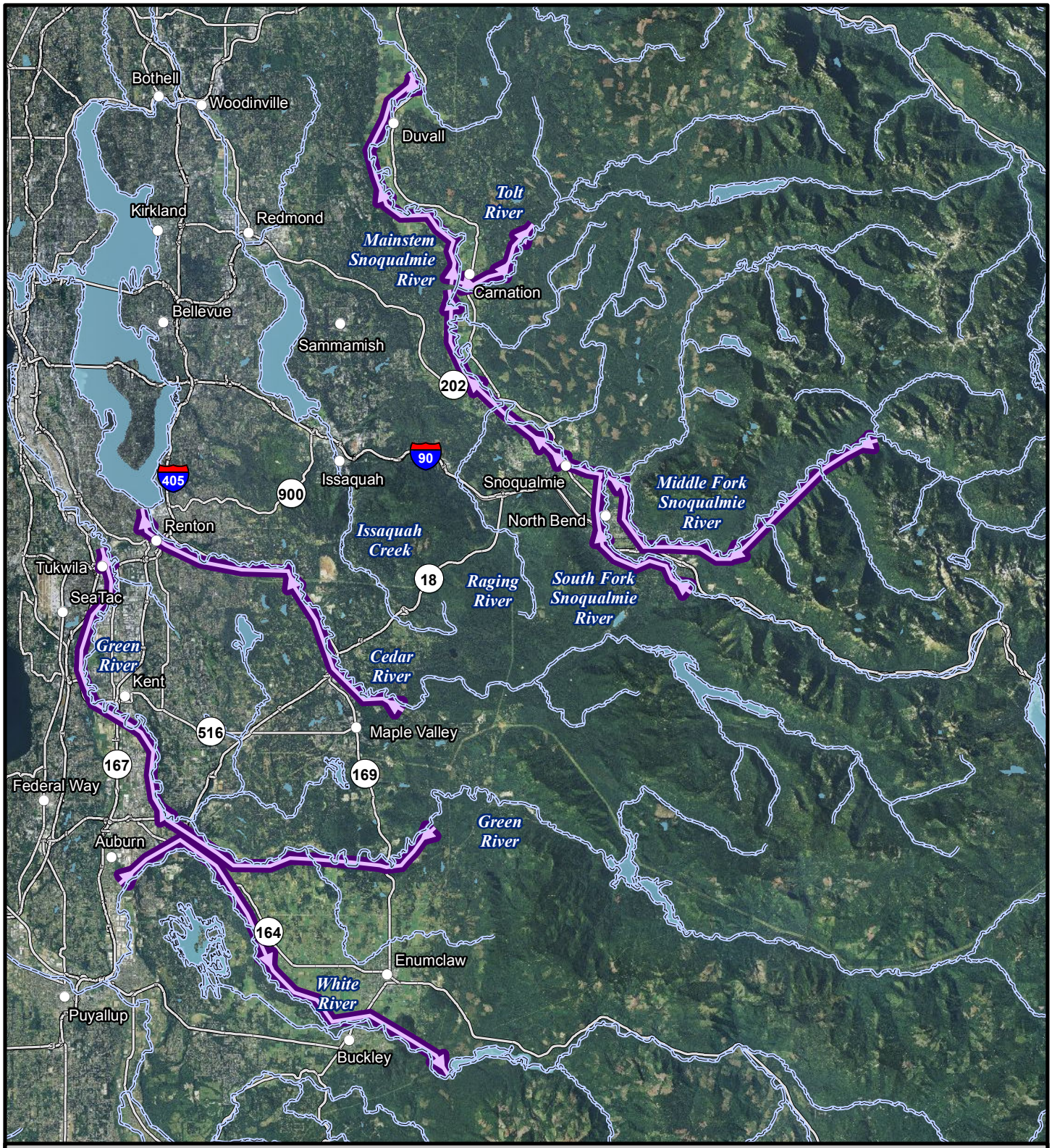


Figure 2. Aerial Survey Flights Conducted for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

Remote Camera Observations

Selection of Camera Locations

Selection of camera locations was based on considerations that varied between river basins:

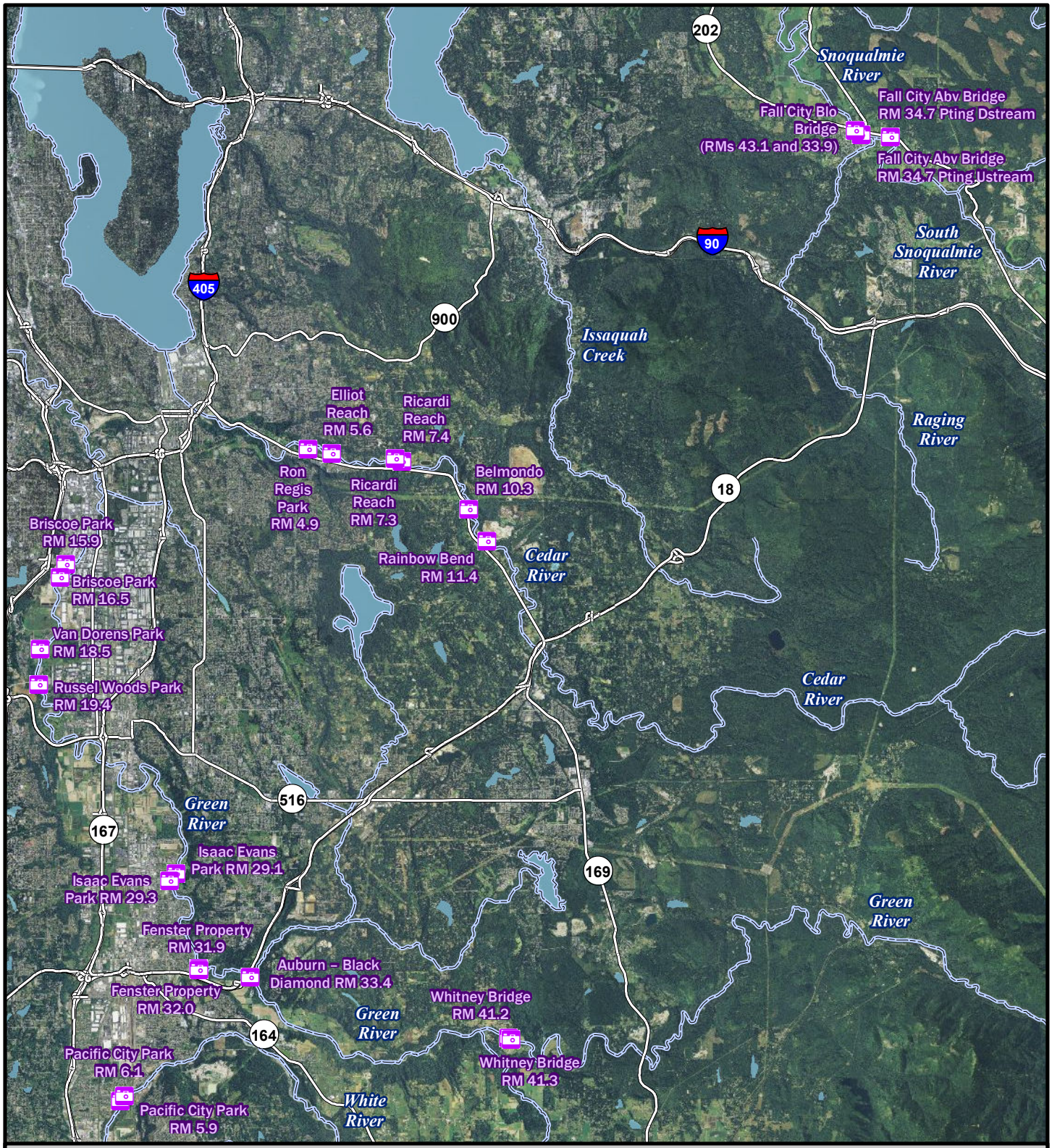
- **Snoqualmie River**: Four cameras were placed on the Snoqualmie River for the purpose of comparing the remote camera data collection method against the field observation method. The cameras were located in an area of known high recreational use.
- **Cedar River**: Six Cedar River cameras were located in project reaches that had been studied in the 2010 Cedar River Recreational Study year. Use is generally high on this river.
- **Green River**: Green River cameras were located in the lower Green River in areas of known recreational use and in reaches where future projects will be constructed. In the middle Green River, cameras were located at both the upstream and downstream ends of a future project reach. Use was expected to be minimal.
- **White River**: Two cameras were located on the White River on a reach where large projects are planned. Use was expected to be limited.

Remote Camera Methods

Observation methods followed a monitoring methodology previously established by King County. Herrera installed 18 cameras over 2 days (June 26 and June 28, 2013) at 11 sites along the Snoqualmie, Cedar, Green, and White Rivers: one camera was installed at each of four sites; and two cameras, one pointing upstream and the other downstream, were installed at each of the other seven sites. Under a separate work order, Herrera installed three additional cameras at two sites on the middle Green River on July 25. One of the middle Green cameras was installed immediately downstream of the Auburn-Black Diamond Road Bridge and pointed upstream. A second camera was installed immediately downstream of the Whitney Bridge and pointed across and upstream. The third camera was installed immediately upstream of the Whitney Bridge and pointed across and downstream. In addition to the 21 cameras installed by Herrera, King County had previously installed three cameras at two sites on the Cedar River. Figure 3 shows the remote camera locations, and Table 1 lists the remote camera locations. Descriptions of the locations of the Herrera-installed cameras are included in Appendix A – Field Observation and Remote Camera Locations – Descriptions.

Cameras were installed 15 to 20 feet above the ground. They were affixed to trees and camouflaged to deter vandalism. The cameras were set to record and electronically store a photo every 10 seconds during daylight hours (although, for consistency with the field observations, only photos taken between 11:00 a.m. and 7:00 p.m. were coded and used in data analysis). Photos from the remote cameras were downloaded up to three times during the study period. After the last download in September, all cameras were removed.

Following each download, the downloaded photos were converted into videos using Plot Watcher Software. The videos were subsequently watched, and the observed recreationists counted and characterized.



Legend

- Remote camera location
- City or town
- Highway
- River

Figure 3. Remote Camera Locations for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 2.25 4.5 9 mi

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

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Table 1. Remote Cameras.			
Name	**Number of Cameras**	**River Mile**	**Bank**
Mainstem Snoqualmie River			
Fall City Above Bridge	2	34.7 / 34.7	Right
Fall City Below Bridge	2	34.1 / 33.9	Right
Cedar River			
Rainbow Bend	1	11.4	Right
Belmondo	1	10.3	Left
Ricardi Reach	2	7.4 / 7.3	Right
Elliot Reach	1	5.6	Right
Ron Regis Park	1	4.9	Left
Green River			
Whitney Bridge	2	41.3 / 41.2	Left
Auburn-Black Diamond	1	33.4	Left
Fenster Property	2	32.0 / 31.9	Left
Isaac Evans Park	2	29.3 / 29.1	Right
Russell Woods Park	1	19.4	Left
Van Doren's Landing Park	1	18.5	Left
Briscoe Park	2	16.5 / 15.9	Right
White River			
Pacific City Park	2	6.1 / 5.9	Right

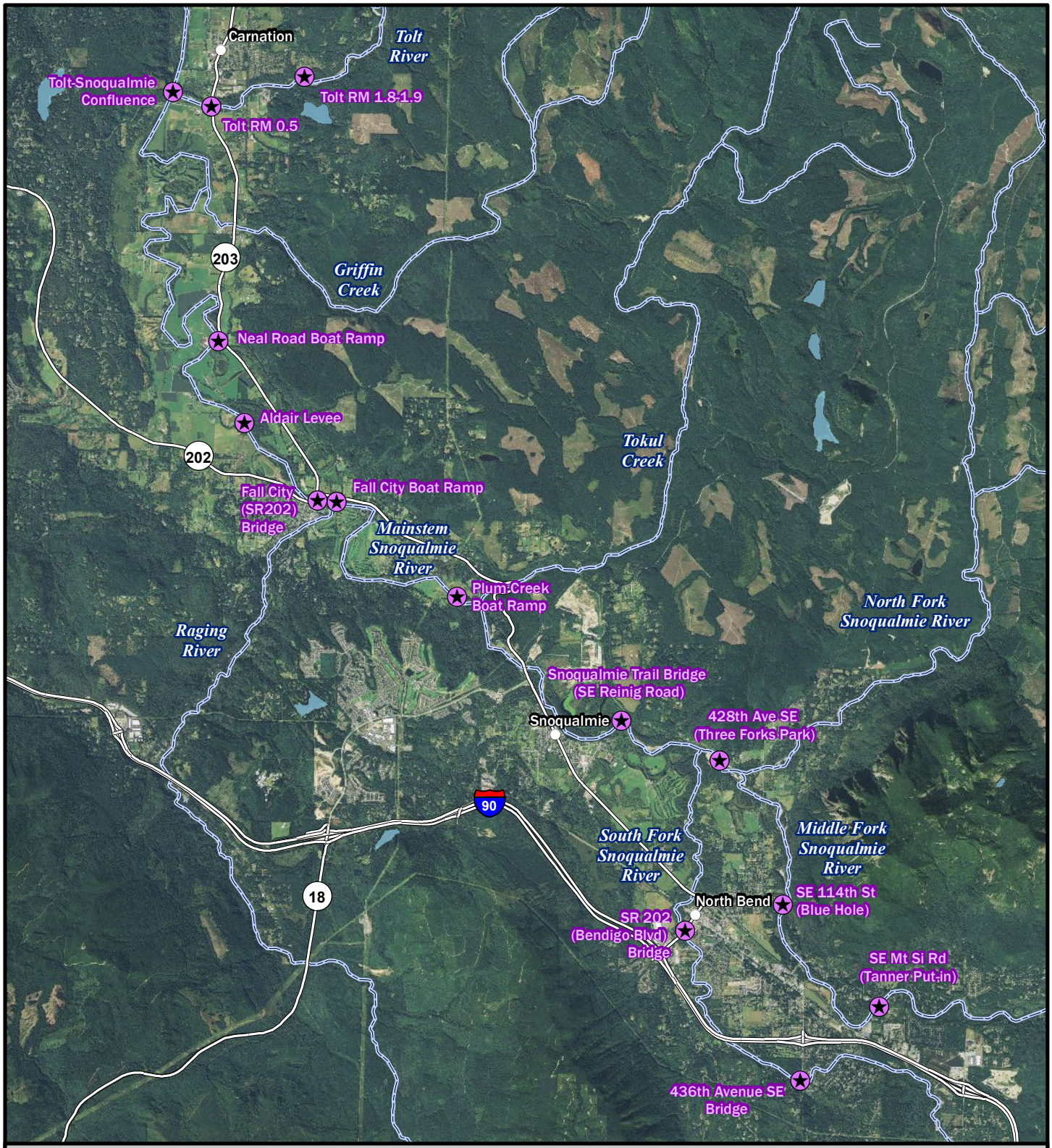
Snoqualmie River System Field Observations

Selection of Field Observation Locations

King County selected observation locations to include known areas of high casual recreational activity, including likely put-in and take-out locations, and encompassing a reasonably diverse geographic area that included locations on the Snoqualmie River mainstem as well as three of the four major tributaries of the Snoqualmie. An initial list of 11 locations was expanded early in the study period to ultimately include a total of 14 locations (see Figure 4, Table 2 below, and Appendix A – Field Observation and Remote Camera Locations – Descriptions).

Field Observation Methods

Herrera conducted observations at each of the field observation locations on a rotating basis. Observation days were selected so that observations were made at each of the selected locations on four weekend days and three midweek days. All observation days had high temperatures that exceeded 70 degrees F (as recorded at North Bend) and were sunny or partly cloudy. An observation session was from 11:00 a.m. to 7:00 p.m. at a single location. Observers stood or sat close to the river edge and recorded characteristics of floaters that included: the number of people in the floating group; the types of floating vessels; general age grouping and gender; and whether they had personal flotation devices, alcohol, paddles or oars, or fishing gear. Where possible, as floaters passed the observer, they were asked where they started their float and where they intended to end their float. Observers also obtained photographs of typical recreational activity. Herrera completed a total of 98 observation sessions on 19 separate days during the study period, which extended from the first observation day on June 22, 2013, through the last observation day on September 11, 2013 (see Appendix C – Data Acquisition Log). Observation sessions were typically grouped so that locations on a given reach were sampled on the same observation day.



Legend

- Field observation site
- City or town
- Highway
- River

Figure 4. Field Observation Sites for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 4,500 9,000 18,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

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Table 2. Field Observation Locations in Snoqualmie River Basin.			
Name	**River**	**River Mile**	**Bank**
436th Avenue SE Bridge	South Fork Snoqualmie River	6.0	Left
Park SR 202 (Bendigo Blvd.) Bridge	South Fork Snoqualmie River	2.9	Right
SE Mt Si Rd (Tanner Put-in)	Middle Fork Snoqualmie River	4.4	Left
SE 114th St (Blue Hole)	Middle Fork Snoqualmie River	2.0	Left
428th Ave SE (Three Forks Park)	Upper Mainstem Snoqualmie River (above the Falls)	42.2	Right
Snoqualmie Trail Bridge (SE Reinig Road)	Upper Mainstem Snoqualmie River (above the Falls)	40.6	Right
Plum Creek Boat Ramp	Lower Mainstem Snoqualmie River (from Falls to Fall City)	37.3	Right
Fall City Boat Ramp	Lower Mainstem Snoqualmie River (from Falls to Fall City)	34.4	Left
Fall City (SR 202) Bridge	Lower Mainstem Snoqualmie River (from Falls to Fall City)	34.2	Left
Aldair Levee	Lower Mainstem Snoqualmie River (from Fall City to Carnation)	32.7	Left
Neal Road Boat Ramp	Lower Mainstem Snoqualmie River (from Fall City to Carnation)	31.0	Right
Tolt RM 1.8 to 1.9	Tolt River	1.9	Right
Tolt RM 0.5	Tolt River	0.5	Right
Tolt-Snoqualmie Confluence	Tolt River	0.0	Right

Comparison with Methodology Used in Cedar River Recreation Study

The methodology used for the field observations closely mimicked the methodology used in the Cedar River Study (Biedenweg and Akyuz 2011).

In-Person Interviews

In collaboration with King County, Confluence Research and Consulting (CRC) and Herrera developed a survey questionnaire (Appendix B – Field Observations and Interview Forms) that contained 13 questions. Interviewers solicited participation from as many groups as possible that were taking out or putting in at the interview locations. Interviewers read the questions to the interviewees and recorded their answers. Interviews were conducted between the hours of 3:00 p.m. and 7:00 p.m.

King County wanted more detailed information about the extents of and influences on recreational use and where interviews would be expected to supplement observational data; and on the White River where little recreational use is known but is expected to be limited to localized swimming or wading, and interviews would be expected to better characterize the typical user. Interviewers attempted to conduct twelve interview sessions, four each on three

separate days: August 11, August 31, and September 1. Interviews were obtained at four locations in the Snoqualmie River system (Figure 5). Interviewers attempted to conduct interviews at other locations in the Snoqualmie River system and at Pacific City Park on the White River, but because of either the absence of floaters during the days that interviewers occupied those locations or the refusal of floaters to participate, no interviews were conducted at those other locations (see Appendix C for list of locations and dates that interviewers attempted to conduct interviews). Figure 5 shows the locations where interviews were conducted.

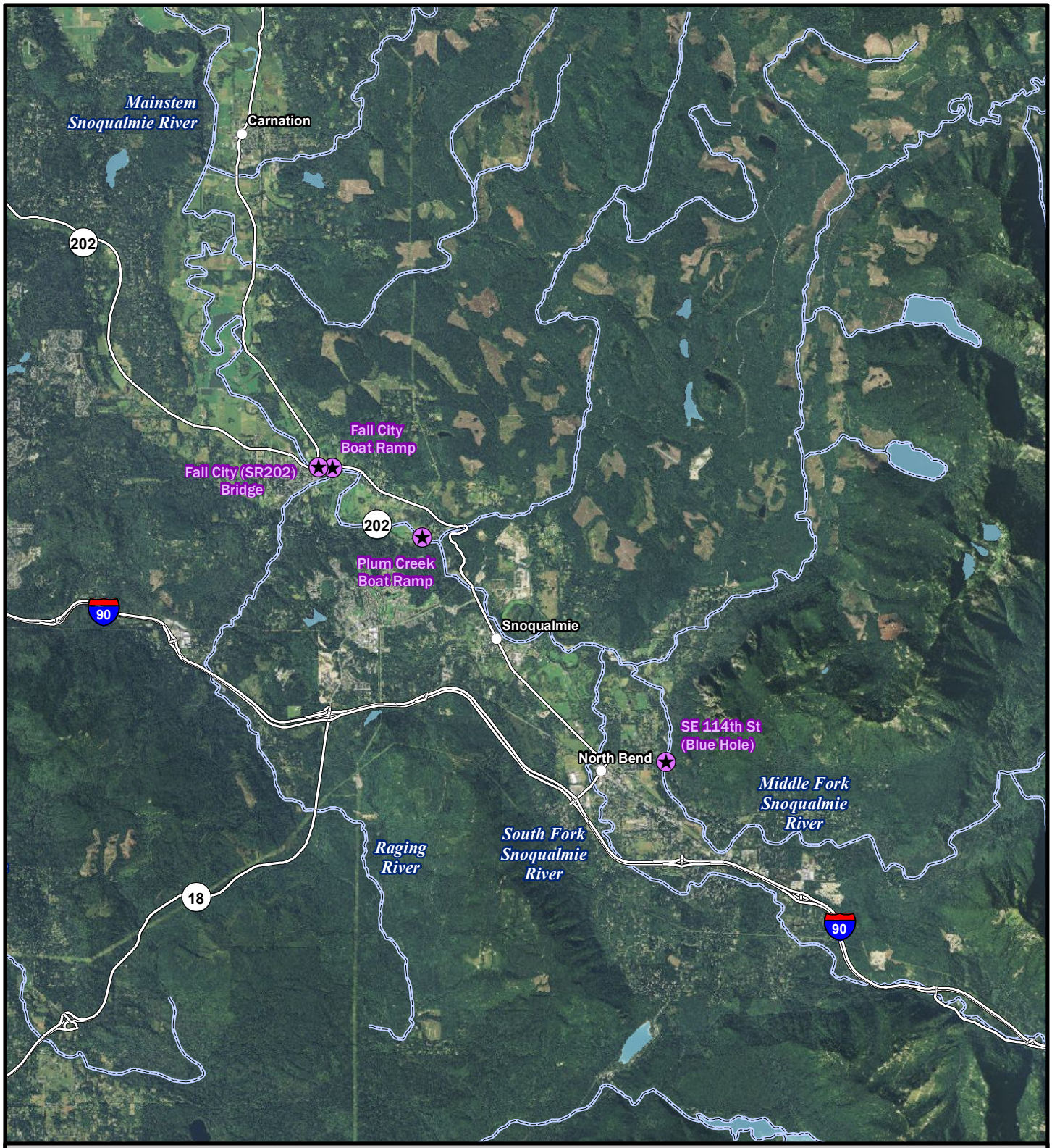
Data Management

Herrera coded all observations in a standardized manner and assigned a unique identifier to each observation, consisting of a three-letter prefix based on site name and an observation number. The data collected from each survey method was then linked to spatial locations for access through an ArcGIS geodatabase. As part of this process, all data was run through a series of quality assurance tests, and observers reviewed and corrected the data as needed. If errors were found that could not be reconciled, the observations were flagged and excluded from further analysis. Results from each observation method were stored as a unique table in a geodatabase for use in mapping and analysis.

- Quality assurance checks were run to ensure that people counted in each age group added up to the total number of people; the sum of all vessel counts was not zero (to exclude swimmers, sunbathers, people fishing, etc.); the number of vessels with paddles was not greater than the total number of vessels; and that the number of people with life vests was not higher than the total number of people.
- Herrera also standardized the take-outs and put-ins database field for mapping purposes based on what was listed in the data and the list provided by the County at the beginning of the project.
- The helicopter data was converted into spatial format based on latitude and longitude data provided by the aerial observer.
- Herrera also reviewed field notes to ensure there was no information in the notes that would disqualify the associated data from being included in the analysis. Excluded data was retained in the database but excluded from analysis.

Statistical Analyses

Herrera performed statistical analyses on the data obtained from the various survey methods to identify specific factors influencing recreational river use in the study area. All analyses were formed using the R software package for statistical computing and graphics. In each individual analysis, statistical significance was evaluated based on an alpha ($\propto$) level of 0.05. The specific analyses that were performed on the data are described in Appendix E.



Legend

- Interview location
- City or town
- Highway
- River

Figure 5. Locations of Recreation Interviews for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

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0 2 4 8 mi

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

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RESULTS AND DISCUSSION

Key results from the study are described below and comprehensively shown in tables and graphics contained in Appendix D – GIS Summary Maps and Tables.

Snoqualmie River

Primary Results

- Approximately 9/10 of all floaters observed in the Snoqualmie River system were observed in the reach of the mainstem between Snoqualmie Falls and Fall City.
- Fewer than 2 percent of all floaters observed in the Snoqualmie River system were observed in the mainstem above Snoqualmie Falls, Middle Fork Snoqualmie River, and South Fork Snoqualmie River.
- Almost 9/10 of all floaters observed in the Snoqualmie River system were adults, and the majority of floaters were male.
- Approximately 9/10 of the vessels used by floaters in the Snoqualmie River system were either rafts or inner tubes.
- Aerial surveys indicated that perhaps as many as 5 to 7 percent of all floaters in the mainstem of the Snoqualmie River used the reach of the mainstem below Carnation.
- Interview respondents were almost entirely local (from King or Pierce Counties).
- Interview respondents generally perceived themselves and their group as being relatively skilled at boating or tubing, and swimming.
- Interview respondents clearly expressed a preference for having information regarding river conditions and hazards made available to them in contrast to having regulations put into place to control or direct floating activity.

Results and Discussion

Survey (Aerial, Remote Camera, Field Observation)

Aerial survey results from the Snoqualmie River basin are provided in Table 8 in the Countywide section of this report and in Figure 2. Remote camera observations and field observations are presented in Tables 3, 4, and 5 below.

Table 3. 2013 Remote Camera Results – Snoqualmie River.			
	Lower Mainstem Snoqualmie River (from Falls to Fall City)	**Lower Mainstem Snoqualmie River (from Fall City to Carnation)**	**Totals for Snoqualmie River System**
Number of Remote Cameras	2	2	4
Number of Days of Camera Operation	182	183	365
Total Groups Recorded	6,365	354	6,719
Average Groups Recorded per Day	35.0	1.9	18.4
Total People Recorded	25,429	926	26,355
Adults (18+)	24,337 (95.7%)	890 (96.1%)	25,227 (95.7%)
Youth (12 to 17)	850 (3.3%)	30 (3.2%)	880 (3.3%)
Children (1 to 11)	242 (1.0%)	6 (0.6%)	248 (0.9%)
Male	15,498 (60.9%)	583 (63.0%)	16,081 (61.0%)
Female	9,931 (39.1%)	343 (37.0%)	10,274 (39.0%)
Average People Recorded per Day	139.7	5.1	72.2
People Wearing Life Vests	1,192 (4.7%)	237 (25.6%)	1,429 (5.4%)
Total Vessels Counted	20,832	686	21,518
Rafts	5,253 (25.2%)	82 (12.0%)	5,335 (24.8%)
Canoes	171 (0.8%)	60 (8.7%)	231 (1.1%)
Kayaks	991 (4.8%)	154 (22.4%)	1,145 (5.3%)
Inner tubes	13,218 (63.5%)	263 (38.3%)	13,481 (62.6%)
Other	1,199 (5.8%)	127 (18.5%)	1,326 (6.2%)
Vessels with Paddles	3,678 (17.7%)	309 (45.0%)	3,987 (18.5%)
Group Had Coolers Visible?			
Yes	2,097 (32.9%)	32 (9.0%)	2,129 (31.7%)
No	2,643 (41.5%)	242 (68.4%)	2,885 (42.9%)
Unsure	1,625 (25.5%)	80 (22.6%)	1,705 (25.4%)
Group Had Alcohol Visible?			
Yes	211 (3.3%)	0 (0.0%)	211 (3.1%)
No	3,039 (47.7%)	288 (81.4%)	3,327 (49.5%)
Unsure	3,115 (48.9%)	66 (18.6%)	3,181 (47.3%)
Group Had Fishing Equipment Visible?			
Yes	79 (1.2%)	22 (6.2%)	101 (1.5%)
No	5,266 (82.7%)	273 (77.1%)	5,539 (82.4%)
Unsure	1,020 (16.0%)	59 (16.7%)	1,079 (16.1%)

Note: All numbers reported are direct counts.

Table 4. 2013 Field Observation Results – Snoqualmie River.	
Number of Observation Locations	14
Cumulative Days of Observation	98
Total Groups Recorded	1,474
Average Groups Recorded per Day	15.0
Total People Recorded	5,938
Adults (18+)	5,209 (87.7%)
Youth (12 to 17)	490 (8.3%)
Children (1 to 11)	239 (4.0%)
Male	3,261 (54.9%)
Female	2,677 (45.1%)
Average People Recorded per Day	60.6
People Wearing Life Vests	709 (11.9%)
Total Vessels Counted	4,602
Rafts	1,284 (27.9%)
Canoes	52 (1.1%)
Kayaks	202 (4.4%)
Inner tubes	2,840 (61.7%)
Other	224 (4.9%)
Vessels with Paddles	1,254 (27.2%)
Group Had Coolers Visible?	
Yes	602 (40.8%)
No	716 (48.6%)
Unsure	156 (10.6%)
Group Had Alcohol Visible?	
Yes	385 (26.1%)
No	976 (66.2%)
Unsure	113 (7.7%)
Group Had Fishing Equipment Visible?	
Yes	40 (2.7%)
No	1,026 (69.6%)
Unsure	408 (27.7%)

Note: All numbers reported are direct counts.

The three sets of data—aerial survey, remote camera, and field—collected in the Snoqualmie River basin indicate that levels of use along the Snoqualmie River were high in 2013, although concentrated along a few specific reaches of the river. The two aerial surveys found a total of 103 groups with 542 people (average group size was 5.3 people) along the river. The average group size was considerably higher than the average group sizes recorded by aerial surveys on the other three county rivers. Seven of the 103 groups were recorded along the mainstem Snoqualmie River downstream of the Tolt-Snoqualmie confluence at Carnation. This data indicates that this reach, which was not surveyed by remote camera or field observations during this study, probably experiences a constant, but low, level of use. During the aerial surveys, 84 (81.6 percent) of the 103 groups recorded in the Snoqualmie River system were observed in the stretch of the mainstem Snoqualmie River between Snoqualmie Falls and Fall City. Other reaches where floaters were observed during the aerial surveys included the South Fork Snoqualmie River (1 group, 1.0 percent of the 103 total), Middle Fork Snoqualmie River (4 groups, 3.9 percent of the 103 total), mainstem Snoqualmie River between Three Forks and Snoqualmie Falls (3 groups, 2.9 percent of the 103 total), and Tolt River (4 groups, 3.9 percent of the 103 total).

The four remote cameras located on the lower mainstem Snoqualmie River (from Falls to Carnation) recorded a total of 6,719 groups comprising a total of 26,355 people over 365 cumulative days of camera operation for an average of 18.4 groups and 72.2 people per day over the entire survey period. Groups were recorded on 254 (69.6 percent) of the 365 days of camera operation. Use levels recorded by remote cameras were not uniform over the 0.8-mile reach of the river containing the remote cameras. The reach bookended by the cameras contained the community of Fall City. Use levels recorded by the two cameras at RM 34.7 upstream of Fall City (6,365 groups and 25,429 people for an average of 35.0 groups and 139.7 people per day) were substantially higher than use levels recorded by the cameras located at RM 34.1 and RM 33.9 downstream of Fall City (354 groups and 926 people for an average of 1.9 groups and 5.1 people per day).

During 98 days of field observations at 14 locations in the Snoqualmie River system, 1,474 groups of floaters with 5,938 people were recorded for an overall average of 15.0 groups and 60.6 people per day over the 98 observation days.

As with the aerial surveys and remote camera observations, field observations recorded the majority of use in the Snoqualmie River system during the study period to have occurred in the reach of the mainstem between Snoqualmie Falls and Fall City. The 21 days of field observations in this reach recorded 1,283 groups (87.0 percent of all groups recorded in the Snoqualmie system by field observations during the study period) and 5,417 people (91.2 percent of all people recorded in the Snoqualmie River system by field observations during the study period), for an average of 61.1 groups and 258.0 people per day during the 21 days of observation. The higher average number of groups and people per day (61.1 groups and 258.0 people) recorded by field observations in this reach compared to the average number of groups and people per day (35.0 and 139.7) recorded by the two remote cameras in this reach is due to the remote cameras recording on all days in the study period while field observations were taken only on days when the temperature exceeded 70 degrees F, therefore excluding the poor-weather, lower-use days captured by the remote camera data.

Table 5. 2013 Field Observation Results by Snoqualmie River Subbasin.						
	South Fork Snoqualmie River	Middle Fork Snoqualmie River	Upper Mainstem Snoqualmie River (above the Falls)	Lower Mainstem Snoqualmie River (from Falls to Fall City)	Lower Mainstem Snoqualmie River (from Fall City to Carnation)	Tolt River
Number of Observation Locations	2	2	2	3	2	3
Number of Observation Days	14	14	14	21	14	21
Total Groups Recorded	14	11	17	1,283	95	54
Average Groups Recorded per Day	1.0	0.8	1.2	61.1	6.8	2.6
Total People Recorded	36	24	48	5,417	267	146
Adults (18+)	19 (52.8%)	17 (70.8%)	24 (50.0%)	4,874 (90.0%)	212 (79.4%)	63 (43.2%)
Youth (12 to 17)	15 (41.7%)	5 (20.8%)	18 (37.5%)	365 (6.7%)	38 (14.2%)	49 (33.6%)
Children (1 to 11)	2 (5.6%)	2 (8.3%)	6 (12.5%)	178 (3.3%)	17 (6.4%)	34 (23.3%)
Male	25 (69.4%)	17 (70.8%)	25 (52.1%)	2,965 (54.7%)	158 (59.2%)	71 (48.6%)
Female	11 (30.6%)	7 (29.2%)	23 (47.9%)	2,452 (45.3%)	109 (40.8%)	75 (51.4%)
Average People Recorded per Day	2.6	1.7	3.4	258.0	19.1	7.0
People Wearing Life Vests	15 (41.7%)	8 (33.3%)	5 (10.4%)	543 (10.0%)	105 (39.3%)	33 (22.6%)
Total Vessels Counted	34	14	40	4,214	178	122
Rafts	2 (5.9%)	4 (28.6%)	25 (62.5%)	1,229 (29.2%)	20 (11.2%)	4 (3.3%)
Canoes	2 (5.9%)	0 (0.0%)	2 (5.0%)	35 (0.8%)	12 (6.7%)	1 (0.8%)
Kayaks	11 (32.4%)	4 (28.6%)	0 (0.0%)	151 (3.6%)	32 (18.0%)	4 (3.3%)
Inner tubes	19 (55.9%)	3 (21.4%)	13 (32.5%)	2,636 (62.6%)	67 (37.6%)	102 (83.6%)
Other	0 (0.0%)	3 (21.4%)	0 (0.0%)	163 (3.9%)	47 (26.4%)	11 (9.0%)
Vessels with Paddles	12 (35.3%)	9 (64.3%)	10 (25.0%)	1,138 (27.0%)	75 (42.1%)	10 (8.2%)
Group Had Coolers Visible?						
Yes	0 (0.0%)	2 (18.2%)	3 (17.6%)	572 (44.6%)	18 (18.9%)	7 (13.0%)
No	12 (85.7%)	9 (81.8%)	12 (70.6%)	584 (45.5%)	53 (55.8%)	46 (85.2%)
Unsure	2 (14.3%)	0 (0.0%)	2 (11.8%)	127 (9.9%)	24 (25.3%)	1 (1.9%)
Group Had Alcohol Visible?						
Yes	1 (7.1%)	0 (0.0%)	0 (0.0%)	376 (29.3%)	6 (6.3%)	2 (3.7%)
No	13 (92.9%)	11 (100.0%)	15 (88.2%)	804 (62.7%)	82 (86.3%)	51 (94.4%)
Unsure	0 (0.0%)	0 (0.0%)	2 (11.8%)	103 (8.0%)	7 (7.4%)	1 (1.9%)
Group Had Fishing Equipment Visible?						
Yes	1 (7.1%)	0 (0.0%)	0 (0.0%)	20 (1.6%)	16 (16.8%)	3 (5.6%)
No	12 (85.7%)	11 (100.0%)	16 (94.1%)	873 (68.0%)	66 (69.5%)	48 (88.9%)
Unsure	1 (7.1%)	0 (0.0%)	1 (5.9%)	390 (30.4%)	13 (13.7%)	3 (5.6%)

Note: All numbers reported are direct counts.

[a] Counts from the Tolt-Snoqualmie confluence included observations of groups on the lowermost Tolt and groups on the Snoqualmie immediately above, at, and immediately below the confluence. The observations are assigned to the appropriate subbasin in the table.

The reach of the Snoqualmie River system with the second highest level of floater use was at the Tolt-Snoqualmie confluence at RM 0 on the Tolt River. At this location, 88 groups and 235 people were recorded in 7 days of field observations for an average of 12.6 groups and 33.6 people per observation day. Based on specifically where they were observed, the 88 groups and 235 people were assigned to either the mainstem Snoqualmie or Tolt Rivers, with the majority (56 groups and 149 people) assigned to the mainstem Snoqualmie River. The third-highest level of floater use was recorded in the mainstem Snoqualmie River between Fall City and the Tolt River. Not including the observations made at the Tolt-Snoqualmie confluence at RM 0.0, a total of 39 groups and 118 people were recorded in 14 days of observations at the Aldair Levee (RM 32.7) and Neal Road Boat Ramp (RM 31.0) for an average of 2.8 groups and 8.4 people in this reach per observation day.

The lowest levels of use recorded in the Snoqualmie River system by field observation occurred along the Tolt River and upstream of Snoqualmie Falls on the mainstem Snoqualmie River and two of its tributaries, the Middle Fork Snoqualmie River and South Fork Snoqualmie River. Along the Tolt River (including floaters that were recorded at the Tolt-Snoqualmie confluence and assigned to the Tolt), field observations recorded 54 groups and 146 people in 21 days of observation for an average of 2.6 groups and 7.0 people per day of observation. Other reaches surveyed by field observation (South Fork Snoqualmie River, Middle Fork Snoqualmie River, and mainstem Snoqualmie River above the Falls), all of which are located upstream of Snoqualmie Falls, had recorded average use levels of fewer than 2.0 groups and 3.5 people per day.

Floaters in the Snoqualmie River system manifested characteristics generally similar to those observed for floaters along other rivers in the county and described later in this report. Floaters were mostly male (61.0 percent recorded by remote camera observations and 54.9 percent recorded by field observations) and mostly adult (95.7 percent recorded by remote camera observations and 87.7 percent recorded by field observations). A minority of floaters wore life vests (5.4 percent recorded by remote camera observations and 11.9 percent recorded by field observations).

As described below for other rivers in the county, the majority of vessels recorded in the Snoqualmie River system were either inner tubes (62.6 percent recorded by remote camera observations and 61.7 percent recorded by field observations) or rafts (24.8 percent recorded by remote camera observations and 27.9 percent recorded by field observations), and approximately 1 in 4 to 1 in 5 had paddles (18.5 percent recorded by remote camera observations and 27.2 percent recorded by field observations). A large minority of groups were observed having coolers (31.7 percent recorded by remote camera observations and 40.8 percent recorded by field observations). A smaller minority of groups were observed to have alcohol (3.1 percent recorded by remote camera observations and 26.1 percent recorded by field observations) and very few groups were observed to have fishing equipment (1.5 percent recorded by remote camera observations and 2.7 percent recorded by field observations).

As described in the preceding paragraphs, the percentages recorded for various group and individual floater characteristics differ between the remote camera and field observations. A modest difference in percentages between the remote camera and field observations is to be

expected because the two methods sampled different subsets of the floater population. Larger differences (for example, in the percentages of groups observed to have alcohol), where the percentages recorded by remote cameras were smaller than the percentages recorded by field observations, can also be due to the greater uncertainty in remote camera observations. This uncertainty is reflected in the substantial percentages characterized as "Unsure."

Interviews

During this 2013 study, 38 interviews were partially or completely filled out. The results are shown in Table F-1 in Appendix F.

Almost all interview respondents were local (King County). Two respondents were from Pierce County. Most interview respondents did not wear personal flotation devices and cited as the reason primarily because they either found flotation devices uncomfortable to wear or because they viewed themselves as sufficiently skilled in boating or swimming. Interview respondents generally rated their group's and their personal abilities at boating, tubing, and swimming as intermediate to skilled.

Interview respondents generally rated potential hazards (e.g., fast water, cold water, other users) as not very hazardous. The one potential hazard that interview respondents tended to rate as somewhat more hazardous was "Fallen trees in river." Interview respondents clearly expressed a preference for having information regarding river conditions and hazards made available to them rather than having regulations put into place to control or direct floating activity.

Attitudes revealed in interview responses were generally similar to attitudes expressed by respondents to interviews conducted as part of the 2010 Cedar River Study (Biedenweg and Akyuz 2011).

Informal Anecdotal Observations

The following informal anecdotal observations were made by field observers during the course of conducting field observations in the Snoqualmie River system. These observations were not made within any structured framework, and therefore are not useful for formal analysis, but rather may provide additional information regarding recreational use at these locations that might be useful.

436th Avenue SE Bridge

The 436th Avenue SE Bridge is a popular spot for fly fishing. By August, locals claimed that the river downstream was likely impassable due to low water and woody debris in the river.

The adjacent levee is a popular walk for locals. There is a small beach 200 meters downstream where people were observed congregating on multiple occasions.

Snoqualmie Trail Bridge (SE Reinig Road)

At the Snoqualmie Trail Bridge (SE Reinig Road), one man was observed arriving in a canoe with a chainsaw covered in sawdust. He said he lived upstream on the South Fork and needed

to make a navigable path to this location, so he sawed his way through some small log jams to make way for his canoe.

The site has a small beach that is a very popular hangout for locals, both adults and large groups of high school kids. Many people swim here, hang out on inner tubes but do not go anywhere, and hang out on a large log in the river that also serves as a small diving platform.

Adults and large groups of high school kids were observed jumping from the bridge into the river, both from the 30-foot main platform, as well as by climbing to the top of the trellis and jumping 60 feet.

Fishermen were observed at this location on multiple occasions.

Aldair Levee

The water's edge cannot be accessed from the Aldair Levee, so there is no easy public access. People were not observed to put in or take out at this site. Most people floating by seemed prepared for the slack water.

Neal Road Boat Ramp

The Neal Road Boat Ramp was primarily used by people with motor boats and jet skis. Kayakers were observed passing by, but they were headed further downstream. Some inner tubers were observed getting out at this site because they realized, too late, that they would not make it to their destination of Carnation before dark. Generally, people on inner tubes and rafts expressed disappointment with their journey from the State Route (SR) 202 bridge to this location.

Tolt RM 1.8 to 1.9

Public access to the Tolt River at RM 1.8 to 1.9 is obscure, so use is dominated by locals who know about the location of the access trail. Nearby residents described the way downstream as impassable without portaging by August because of low water levels. Even in July, one couple said that they had to fight their way through woody debris to get from upstream to the observation site. An observer spoke with them at the 0.5-mile bridge, by which point they had lost a kayak and were scratched up from fighting brush.

At least three people were observed at this location on multiple occasions playing fetch with their dogs in the river. They were nearby residents. One woman was observed swimming down a 600-foot reach of the river with her dog on multiple occasions.

One nearby resident was hostile, claiming the levee access as his private property, which it apparently is not.

Tolt-Snoqualmie Confluence

People were observed putting in on the Tolt River just upstream of the confluence with the Snoqualmie River, floating around the corner and along a short extent of the beach, taking out, and then repeating this several times. Many people deployed inner tubes and rafts from the shore and attached them with rope to trees to just hang out in the river at this site. The beach at this location is a popular picnic area.

Cedar River

Primary Results

- Approximately 95 percent of all floaters observed on the Cedar River were observed at Ricardi Reach (MP 7.4) and downstream of that location.
- In contrast to the situation in 2010, floater use of the Rainbow Bend-Belmondo Reach (RM 11.4 to 10.3) was very low due to a river closure in that portion of the Cedar River.
- Use of life vests by floaters on the Cedar River in 2013 was substantially lower than the level of life vest use observed in 2011 after the County Council passed temporary Ordinance 17124.
- Almost 3/4 of all floaters observed in the Cedar River system were adults, and about 2/3 were male.
- More than 9/10 of the vessels used by floaters in the Cedar River system were either rafts or inner tubes.

Results and Discussion

Cedar River Recreation Study

Among the findings resulting from the May-September 2010 field observations conducted in the Cedar River Study (Biedenweg and Akyuz 2011) were the following:

- Over 1,900 floaters in 550 groups (median group size of 3) were observed over the study period.
- 73 percent of floaters were adults (over 18 years old), 18 percent were youth (judged to be 12 to 17 years old), and 9 percent were children (under age 12).
- Gender breakdown of floaters was 65 percent male and 35 percent female.
- The breakdown of vessel types observed was:
    - Approximately 84 percent inner tubes or air mattresses
    - Approximately 12 percent rafts
    - Approximately 5 percent kayaks, pontoons, or canoes
- 13 percent of vessels had oars or paddles.
- 26 percent of the groups were visibly drinking alcohol, with another 15 percent possibly having alcohol in observed coolers or other containers.
- 5 percent of adults, 2 percent of youth, and 39 percent of children were observed to be wearing personal flotation devices

Regression analysis indicated that approximately 6,700 persons floated the Cedar River between Landsburg Dam and I-405 between May and September 2010 (Biedenweg and Akyuz 2011).

2013 Study

Aerial survey results from the Cedar River basin are provided in Table 8 in the Countywide section that follows, and on Figure 2. Remote camera observations are presented in Table 6 below.

Both sets of data—aerial survey and remote camera—indicate that levels of use along the Cedar River were moderate. The two aerial surveys found a total of 4 groups with 9 people (average group size was 2.2 people) along the river, all of whom were recorded outside of the 6.5-mile stretch of the river containing the six remote camera locations. One group recorded in the aerial surveys was observed upstream of Rainbow Bend, where the furthest upstream camera was located, and the other three groups recorded in the aerial surveys were observed downstream of Ron Regis Park, the location of the furthest downstream camera.

The six remote cameras recorded a total of 1,452 groups comprising a total of 3,681 people over 534 cumulative days of camera operation for an average of 2.7 groups and 6.9 people per day over the entire survey period. Groups were recorded on 250 (46.8 percent) of the 534 days of camera operation.

Use levels recorded by remote cameras were not uniform over the 6.5-mile reach of the river (Rainbow Bend RM 11.4 downstream to Ron Regis Park RM 4.9) containing the remote cameras. The highest use levels on the Cedar River of 7.1 groups per day and 16.1 people per day over the entire survey period were recorded at Elliott Reach RM 5.6. Low use levels were recorded at Rainbow Bend RM 11.4 (0.3 groups and 0.6 people per day) and Belmondo RM 10.3 (0.3 groups and 1.0 people per day), the furthest upstream cameras (the reasons for this low level of use are discussed below).

Floaters on the Cedar River manifested characteristics similar to those observed for floaters along other rivers in the county. Floaters were mostly male (69.6 percent) and mostly adult (92.1 percent), and a minority of floaters (12.6 percent) wore life vests.

As on other rivers in the county, the majority of vessels recorded were either inner tubes (79.6 percent) or rafts (14.3 percent), and fewer than 1 in 6 (15.1 percent) had paddles. The data indicate that over 3/4 of groups had no coolers, alcohol, or fishing equipment, although the specific percentages are uncertain because of uncertainties in the information derived from the remote cameras.

Table 6. 2013 Remote Camera Results - Cedar River.				
	Rainbow Bend RM 11.4 RB – Belmondo RM 10.3 LB	**Ricardi Reach RM 7.4 and 7.3 RB**	**Elliot Reach RM 5.6 RB – Ron Regis Park RM 4.9 LB**	**Totals for Cedar River System**
Number of Remote Cameras	2	2	2	6
Number of Days of Camera Operation	207	163	164	534
Total Groups Recorded	63	736	653	1,452
Average Groups Recorded per Day	0.3	4.5	4.0	2.7
Total People Recorded	156	1,984	1,541	3,681
Adults (18+)	128 (82.1%)	1,897 (95.6%)	1,366 (88.6%)	3,391 (92.1%)
Youth (12 to 17)	25 (16.0%)	66 (3.3%)	138 (9.0%)	229 (6.2%)
Children (1 to 11)	3 (1.9%)	21 (1.1%)	37 (2.4%)	61 (1.7%)
Male	117 (75.0%)	1,372 (69.2%)	1,071 (69.5%)	2,560 (69.6%)
Female	39 (25.0%)	612 (30.8%)	470 (30.5%)	1,121 (30.5%)
Average People Recorded per Day	0.8	12.2	9.4	6.9
People Wearing Life Vests	46 (29.5%)	176 (8.9%)	243 (15.8%)	465 (12.6%)
Total Vessels Counted	124	1,813	1,368	3,227
Rafts	25 (20.2%)	264 (14.6%)	172 (12.6%)	461 (14.3%)
Canoes	1 (0.8%)	7 (0.4%)	4 (0.3%)	12 (0.4%)
Kayaks	24 (19.4%)	94 (5.2%)	49 (3.6%)	167 (5.2%)
Inner tubes	67 (54.0%)	1,410 (77.8%)	1,090 (79.7%)	2,567 (79.6%)
Other	7 (5.6%)	38 (2.1%)	53 (3.9%)	98 (3.0%)
Vessels with Paddles	53 (42.7%)	250 (13.8%)	184 (13.5%)	487 (15.1%)

Table 6 (continued). 2013 Remote Camera Results - Cedar River.				
	Rainbow Bend RM 11.4 RB – Belmondo RM 10.3 LB	**Ricardi Reach RM 7.4 and 7.3 RB**	**Elliot Reach RM 5.6 RB – Ron Regis Park RM 4.9 LB**	**Totals for Cedar River System**
Group Had Coolers Visible?				
Yes	7 (11.1%)	60 (8.2%)	63 (9.6%)	130 (9.0%)
No	51 (81.0%)	473 (64.3%)	572 (87.6%)	1,096 (75.5%)
Unsure	5 (7.9%)	203 (27.6%)	18 (2.8%)	226 (15.6%)
Group Had Alcohol Visible?				
Yes	0 (0.0%)	3 (0.4%)	18 (2.8%)	21 (1.4%)
No	63 (100.0%)	476 (64.7%)	612 (93.7%)	1,151 (79.3%)
Unsure	0 (0.0%)	257 (34.9%)	23 (3.5%)	280 (19.3%)
Group Had Fishing Equipment Visible?				
Yes	4 (6.3%)	12 (1.6%)	7 (1.1%)	23 (1.6%)
No	56 (88.9%)	578 (78.5%)	643 (98.5%)	1,277 (88.0%)
Unsure	3 (4.8%)	146 (19.8%)	3 (0.5%)	152 (10.5%)

Note: All numbers reported are direct counts.

The 2013 remote camera and 2010 field observations yielded broadly similar results regarding floater characteristics given the different years of the data and the differing methods of data collection (e.g., as described earlier, some user characteristics, such as age, gender, and alcohol use, can be more uncertain when obtained from remote cameras than when obtained by field observations). Despite these uncertainties, there are some notable differences and trends among the 2010, 2011 (PFD monitoring), and 2013 data that are not attributable solely to the differing methodologies. The number of users per day on the Cedar River was substantially lower in 2013 (6.9 people per day averaged over the cumulative days of camera operation) than in 2010 (40.0 people per day averaged over the cumulative days of field observations). The lower number of people per day in 2013 can be attributed at least in significant part to the 2013 closure of the Cedar River at what in 2010 was the most popular access point (Rainbow Bend RM 11.4). The reach in the vicinity of Rainbow Bend RM 11.4 was closed because of a 4-foot-diameter spanning log and two major in-water construction projects. (K. Akyuz, personal communication 2014).

In 2010, life vest use was observed in 8 percent of floaters. Following passage of temporary Ordinance 17124 requiring that personal flotation devices (PFD) be worn in King County's major rivers from June 21 to October 31, 2011, and with the associated outreach to encourage use of life vests, monitoring in 2011 found that life vests were worn by 30 percent of floaters, a significant increase from 2010. The 2013 cameras on the Cedar River, however, recorded that life vest use had decreased; and only 13 percent of floaters on the Cedar River used life vests. This result indicates that the temporary ordinance and associated outreach, which had an immediate short-term effect in 2011 to increase life vest use, would probably need to be in place over a longer term to have the effect of increasing the percentage of floaters using life vests on a more permanent basis.

Green River

Primary Results

- Within the portion of the Green River surveyed (RM 41.3 to 15.9) use levels generally declined downstream.
- The highest levels of floater use observed on the Green River occurred in the vicinity of the Whitney Bridge (RM 41.3 to 41.1).
- The number of floaters in the Kent area (RM 19.4 to 15.9) was about 1/40 of the number of floaters in the vicinity of Whitney Bridge.
- Nearly 9/10 of all floaters observed in the Green River system were adults and about 2/3 were male.
- Approximately 85 percent of the vessels used by floaters in the Green River system were either rafts or inner tubes.

Results and Discussion

Aerial survey results from the Green River basin are provided in Table 8 in the Countywide section of this report, and on Figure 2. Remote camera observations, broken down by Green River reach, are presented in Table 7 below.

Both sets of data—aerial survey and remote camera—indicate that levels of use along the Green River were moderate. The two aerial surveys found a total of 16 groups with 41 people (average group size was 2.6 people) along the river, all of whom were recorded within the 25.4-mile stretch of the river (Whitney Bridge RM 41.3 downstream to Briscoe Park RM 15.9) containing the 11 remote camera locations.

The 11 remote cameras recorded a total of 1,642 groups comprising a total of 5,105 people observed over 795 cumulative days of camera operation for an average of 2.1 groups and 6.4 people per day over the entire survey period. Groups were recorded on 345 (43.4 percent) of the 795 days of camera operation.

Use levels recorded by remote cameras were not uniform over the 25.4-mile stretch of the river containing the remote cameras. Based on the use levels recorded in 2013, the portion of the Green River surveyed by remote cameras can be divided into three reaches—a relatively high-use reach in the vicinity of the Whitney Bridge RM 41.3 and 41.2 (an average of 6.6 groups and 21.8 people per day over the survey period), a medium-use reach extending from the Auburn-Black Diamond Road RM 33.4 downstream to Isaac Evans Park RM 29.1 in Auburn (an average of 2.3 groups and 7.0 people per day over the survey period), and a low-use reach in the Kent/Tukwila area extending from Russell Woods Park RM 19.4 to Briscoe Park RM 15.9 (an average of 0.3 groups and 0.5 people per day over the survey period).

Floaters on the Green River manifested characteristics similar to those observed for floaters along other rivers in the county. Floaters were mostly male (64.6 percent) and mostly adult (88.2 percent), and a minority of floaters (13.6 percent) wore life vests. Floater characteristics on the Green River generally varied by use level. The lower the level of use, the higher the percentage of males tended to be, with a less consistent, but still discernable, tendency for there to be higher percentages of adults and lower percentages of children in the lowest use levels. This gender and age pattern was, however, not manifested in the 2013 data from other rivers.

As on other rivers in the county, the majority of vessels recorded were either inner tubes (65.1 percent) or rafts (19.3 percent), and fewer than 1 in 4 (22.6 percent) groups had paddles. As noted previously, although the data indicate that the majority of groups had no coolers, alcohol, or fishing equipment, specific percentages are uncertain because of the difficulty in obtaining this particular information about groups from the remote cameras.

Table 7. 2013 Remote Camera Results – Green River.				
	Whitney Bridge RM 41.3 and 41.1 LB	**Auburn-Black Diamond RM 33.4 LB to Isaac Evans Park RM 29.1 RB**	**Russell Woods Park RM 19.4 LB to Briscoe Park RM 15.9 RB**	**Totals for Green River System**
Number of Remote Cameras	2	5	4	11
Number of Days of Camera Operation	106	376	313	795
Total Groups Recorded	701	860	81	1,642
Average Groups Recorded per Day	6.6	2.3	0.3	2.1
Total People Recorded	2,312	2,626	167	5,105
Adults (18+)	2,128 (92.0%)	2,220 (84.5%)	157 (94.0%)	4,505 (88.2%)
Youth (12 to 17)	106 (4.6%)	260 (9.9%)	7 (4.2%)	373 (7.3%)
Children (1 to 11)	78 (3.4%)	146 (5.6%)	3 (1.8%)	227 (4.4%)
Male	1,441 (62.3%)	1,726 (65.7%)	129 (77.2%)	3,296 (64.6%)
Female	871 (37.7%)	900 (34.3%)	38 (22.8%)	1,809 (35.4%)
Average People Recorded per Day	21.8	7.0	0.5	6.4
People Wearing Life Vests	254 (11.0%)	322 (12.3%)	118 (70.7%)	694 (13.6%)
Total Vessels Counted	2,016	2,103	131	4,250
Rafts	281 (13.9%)	526 (25.0%)	12 (9.2%)	819 (19.3%)
Canoes	29 (1.4%)	49 (2.3%)	14 (10.7%)	92 (2.2%)
Kayaks	58 (2.9%)	103 (4.9%)	84 (64.1%)	245 (5.8%)
Inner tubes	1,556 (77.2%)	1,204 (57.3%)	8 (6.1%)	2,768 (65.1%)
Other	92 (4.6%)	221 (10.5%)	13 (9.9%)	326 (7.7%)
Vessels with Paddles	283 (14.0%)	566 (26.9%)	112 (85.5%)	961 (22.6%)

Table 7 (continued). 2013 Remote Camera Results – Green River.				
	Whitney Bridge RM 41.3 and 41.1 LB	**Auburn-Black Diamond RM 33.4 LB to Isaac Evans Park RM 29.1 RB**	**Russell Woods Park RM 19.4 LB to Briscoe Park RM 15.9 RB**	**Totals for Green River System**
Group Had Coolers Visible?				
Yes	85 (12.1%)	202 (23.5%)	24 (29.6%)	311 (18.9%)
No	441 (62.9%)	373 (43.4%)	47 (58.0%)	861 (52.4%)
Unsure	175 (25.0%)	285 (33.1%)	10 (12.3%)	470 (28.6%)
Group Had Alcohol Visible?				
Yes	3 (0.4%)	60 (7.0%)	0 (0.0%)	63 (3.8%)
No	470 (67.0%)	447 (52.0%)	68 (84.0%)	985 (60.0%)
Unsure	228 (32.5%)	353 (41.0%)	13 (16.0%)	594 (36.2%)
Group Had Fishing Equipment Visible?				
Yes	5 (0.7%)	11 (1.3%)	5 (6.2%)	21 (1.3%)
No	522 (74.5%)	628 (73.0%)	75 (92.6%)	1,225 (74.6%)
Unsure	174 (24.8%)	221 (25.7%)	1 (1.2%)	396 (24.1%)

Note: All numbers reported are direct counts.

White River

Primary Results

- The number of floaters observed on the White River was extremely low, about 1 group every 10 days.
- Floater characteristics appear to have been similar to those observed in the other river systems.

Results and Discussion

Aerial survey results from the White River basin are provided in Table 8 in the Countywide section below and on Figure 2. Remote camera results from the White River basin are presented in Table 9 in the Countywide section.

Both sets of data—aerial survey and remote camera—indicate that the levels of use along the White River were quite low. The two aerial surveys found a total of 2 groups with 5 people (average group size was 2.5 people) along the river in King County, with both groups recorded in the stretch of river downstream of the remote camera locations at Pacific City Park.

The two remote cameras at Pacific City Park RM 6.1 and RM 5.9 recorded a total of 13 groups including 30 people observed over a total of 168 cumulative days of camera operation for an average of 0.08 groups and 0.18 people per day over the entire survey period. Groups were recorded on only 9 (5.3 percent) of the 168 days of camera operation.

The small set of floaters recorded along the White River manifested characteristics similar to those observed for floaters along other rivers in the county. Floaters were mostly male (80 percent) and mostly (in the case of the White River, entirely) adult, and a minority of floaters (20 percent) wore life vests. The percentage of floaters that were male, the percentage that were adult, and the percentage that wore life vests all were higher than recorded on any of the other three rivers in the county; but the significance of this is unclear because of the small sample size.

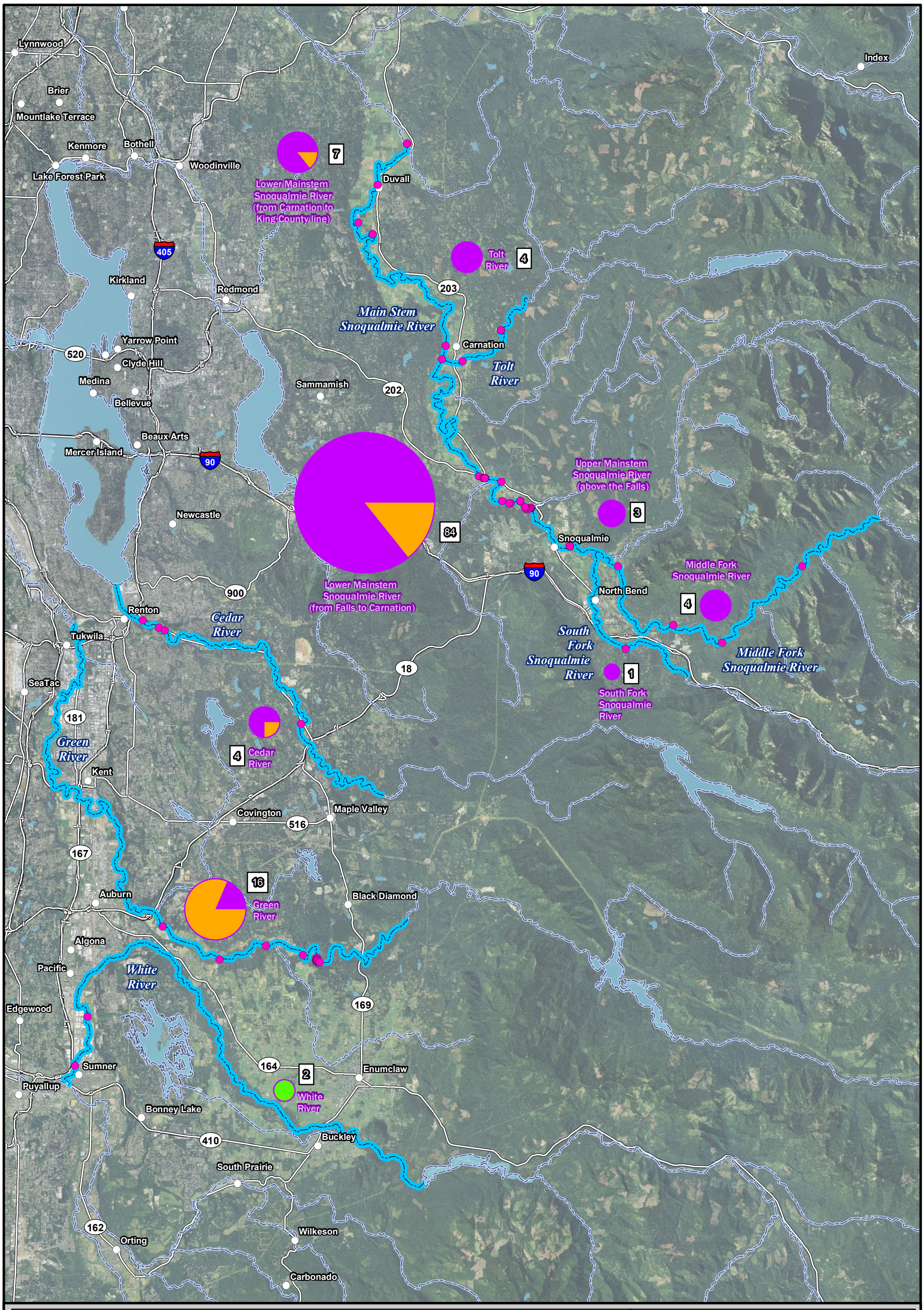
Most (over 92 percent) of the vessels recorded were informal—inner tubes and rafts, and fewer than 1 in 5 (19.2 percent) had paddles. As on the other three rivers, data indicate that the majority of groups had no coolers, alcohol, or fishing equipment.

Countywide

The number of groups counted during aerial surveys and by remote cameras and field observations are shown in Figures 6 through 8 and Tables 8, 9, and 10.

Table 11 provides a listing of all reaches surveyed by remote camera, ordered by level of use (average number of groups and people per day).

Table 11 indicates that, in 2013, 68.9 percent of all floaters floated the reach of the mainstem Snoqualmie River between Snoqualmie Falls and Fall City, and more than 9 in 10 (90.2 percent) floaters floated on just three reaches—the mainstem Snoqualmie River between Snoqualmie Falls and Fall City, the Green River in the vicinity of the Whitney Bridge, and the Cedar River in the vicinity of Ricardi Reach at RM 7.4 to Ron Regis Park at RM 4.9.



Legend

Total Groups Counted: 17

- Aerial survey observation location
- Aerial survey reach
- City or town
- Highway
- River

- July 7, 2013
- August 13, 2013
- August 24, 2013

Figure 6. Total Groups Counted by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

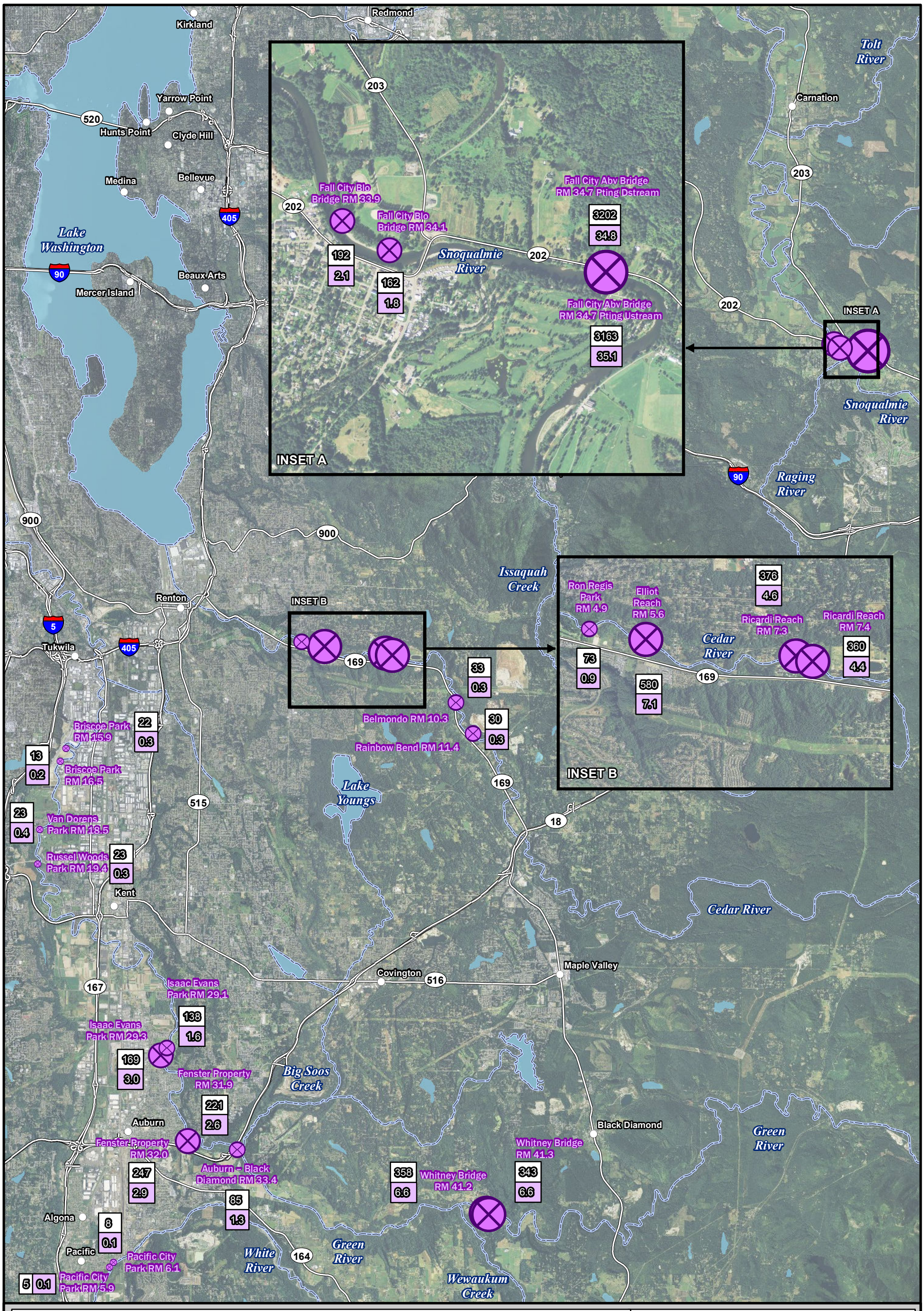
N

0 2 4 8 Miles

King County

Aerial: USDA (2013)
Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Total_Observations.mxd (10/6/2014)



Legend

Total Groups Counted: 17

- <= 25
- 26 to 150
- 151 to 300
- 301 to 1000
- > 1000

6.6 Groups per day

- City or town
- Highway
- River

Figure 7. Total Groups Counted by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

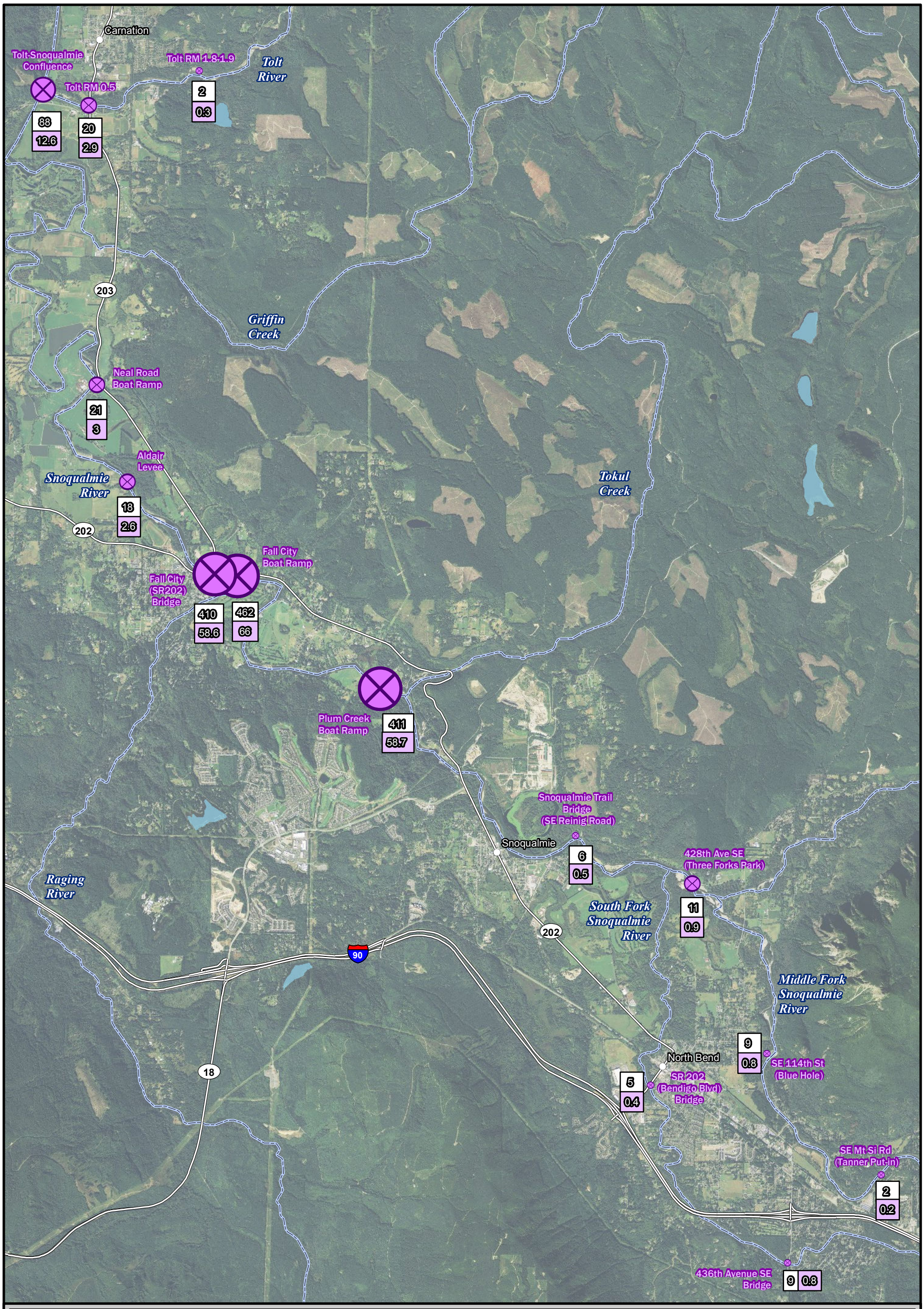
N

0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)
Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_total_groups.mxd (10/6/2014)



Legend

Total Groups Counted 17

- <= 10
- 11 to 25
- 26 to 100
- 101 to 250
- > 250

6.6 Groups per day

- City or town
- Highway
- River

Figure 8. Total Groups Counted by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\observation_total_groups.mxd (10/6/2014)

Table 12 below summarizes the 2013 aerial survey, remote camera, and field observations, and compares those 2013 observations to the 2010 Cedar River field observations (Biedenweg and Akyuz 2011) and the County's 2011 lifejacket monitoring.

Considering the variability in the timing and methodologies of the various studies, the results shown in Table 12 are broadly similar, except for the percentages of floaters using life vests. The reasons for this exception are discussed above in the section describing the results from the Cedar River.

Statistical Analysis of Survey Results

Data from the 2013 field observations and remote cameras were evaluated for statistically significant relationships between field-documented variables. Detailed summaries of results from statistical analyses are presented in Appendix E – Statistical Analysis. General trends that were identified from the analyses are as follows:

- Based on analyses of both the field observation data and remote camera observation data, more groups and more people were observed on the river late in the day (3:00 p.m. to 7:00 p.m.) in comparison to earlier in the day (11:00 a.m. to 3:00 p.m.).
- Based on analyses of both the field observation data and remote camera observation data, more groups and more people were observed on the river on weekends in comparison to weekdays.
- Based on analyses of both the field observation data and remote camera observation data, more groups and more people were observed during the peak season (July 4 to September 2) in comparison to the off-peak season.
- Based on analyses of the field observation data, there was generally a positive relationship between the presence of children and life vests in a group.
- Based on analyses of the field observation data, there was generally a negative relationship between the presence of children/youths and alcohol/coolers in a group.
- Based on analyses of the remote camera observation data, there was strong positive relationship between the average number of groups observed across all sites and the maximum daily temperature on a given day.
- Based on analyses of the remote camera observation data, there was a strong positive relationship between the average number of groups observed across all sites and the maximum daily temperature on a given day.
- Based on analyses of the remote camera observation data, average daily flow could not be used to reliably predict the average number of people or groups at the majority of sites.

Estimates of total summer season use are shown in Table 13. More detail on the results and the methodology used can be found in Appendix E.

Extrapolating from the total estimated number of floaters on the four rivers from July 4, 2013, to September 2, 2013, the overall number of floaters on the four county rivers between

(and including) May 25, 2013, the Saturday before Memorial Day, and September 30, 2013, was approximately 28,000, with about 56 percent of those floaters on the rivers between July 4 and Labor Day.

Table 8. 2013 Aerial Survey Observations – Countywide.

	Snoqualmie River	Cedar River	Green River	White River	Totals
Total Groups Observed	103	4	16	2	125
Total People Observed	542	9	41	5	597
Adults (18+)	507 (93.5%)	9 (100.0%)	39 (95.1%)	5 (100.0%)	560 (93.8%)
Youth (12 to 17)	29 (5.4%)	0 (0.0%)	2 (4.9%)	0 (0.0%)	20 (3.4%)
Children (1 to 11)	17 (3.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (2.8%)
Male	318 (58.7%)	5 (55.6%)	24 (58.5%)	2 (40.0%)	349 (58.5%)
Female	224 (41.3%)	4 (44.4%)	17 (41.5%)	3 (60.0%)	248 (41.5%)
People Wearing Life Vests	72 (13.3%)	2 (22.2%)	15 (36.6%)	1 (20.0%)	90 (15.1%)
Total Vessels Counted	432	6	37	3	478
Rafts	104 (24.1%)	1 (16.7%)	6 (16.2%)	0 (0.0%)	111 (23.2%)
Canoes	1 (0.2%)	0 (0.0%)	2 (5.4%)	0 (0.0%)	3 (0.6%)
Kayaks	32 (7.4%)	2 (33.3%)	1 (2.7%)	1 (33.3%)	36 (7.5%)
Inner tubes	264 (61.1%)	2 (33.3%)	25 (67.6%)	2 (66.7%)	293 (61.3%)
Other	31 (7.2%)	1 (16.7%)	3 (8.1%)	0 (0.0%)	35 (7.3%)
Vessels with Paddles	101 (23.4%)	3 (50.0%)	11 (29.7%)	0 (0.0%)	115 (24.1%)
Group Had Coolers Visible?					
Yes	38 (36.9%)	0 (0.0%)	3 (18.8%)	0 (0.0%)	41 (32.8%)
No	64 (62.1%)	2 (50.0%)	10 (62.5%)	2 (100.0%)	78 (62.4%)
Unsure	1 (1.0%)	2 (50.0%)	3 (18.8%)	0 (0.0%)	6 (4.8%)
Group Had Alcohol Visible?					
Yes	43 (41.7%)	0 (0.0%)	1 (6.3%)	0 (0.0%)	44 (35.2%)
No	59 (57.3%)	2 (50.0%)	15 (93.8%)	2 (100.0%)	78 (62.4%)
Unsure	1 (1.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)	3 (2.4%)
Group Had Fishing Equipment Visible?					
Yes	1 (1.0%)	0 (0.0%)	2 (12.5%)	0 (0.0%)	3 (2.4%)
No	101 (98.1%)	2 (50.0%)	14 (87.5%)	2 (100.0%)	119 (95.2%)
Unsure	1 (1.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)	3 (2.4%)

Note: All numbers reported are direct counts.

Table 9. 2013 Remote Camera Observations – Countywide.					
	Snoqualmie River	**Cedar River**	**Green River**	**White River**	**Totals**
Number of Cameras	4	6	11	2	23
Cumulative Days of Camera Operation	365	534	795	168	1,862
Total Groups Recorded	6,719	1,452	1,642	13	9,862
Average Groups Recorded per Day	18.4	2.7	2.1	0.1	5.3
Total People Recorded	26,355	3,681	5,105	30	35,171
Adults (18+)	25,227 (95.7%)	3,391 (92.6%)	4,505 (88.2%)	30 (100.0%)	33,025 (94.3%)
Youth (12 to 17)	880 (3.3%)	229 (5.8%)	373 (7.3%)	0 (0.0%)	1,457 (4.2%)
Children (1 to 11)	248 (0.9%)	61 (1.6%)	227 (4.4%)	0 (0.0%)	533 (1.5%)
Male	16,081 (61.0%)	2,560 (69.3%)	3,296 (64.6%)	24 (80.0%)	21,844 (62.4%)
Female	10,274 (39.0%)	1,121 (30.7%)	1,809 (35.4%)	6 (20.0%)	13,171 (37.6%)
Average People Recorded per Day	72.2	6.9	6.4	0.2	18.9
People Wearing Life Vests	1,429 (5.4%)	465 (11.9%)	694 (13.6%)	6 (20.0%)	2,548 (7.3%)
Total Vessels Counted	21,518	3,227	4,250	26	28,975
Rafts	5,335 (24.8%)	461 (13.7%)	819 (19.3%)	3 (11.5%)	6,593 (22.8%)
Canoes	231 (1.1%)	12 (0.3%)	92 (2.2%)	1 (3.8%)	335 (1.2%)
Kayaks	1,145 (5.3%)	167 (4.5%)	245 (5.8%)	0 (0.0%)	1,533 (5.3%)
Inner tubes	13,481 (62.6%)	2,567 (78.6%)	2,768 (65.1%)	21 (80.8%)	18,770 (64.8%)
Other	1,326 (6.2%)	98 (2.9%)	326 (7.7%)	1 (3.8%)	1,744 (6.0%)
Vessels with Paddles	3,987 (18.5%)	487 (13.6%)	961 (22.6%)	5 (19.2%)	5,388 (18.6%)

Table 9 (continued). 2013 Remote Camera Observations – Countywide.					
	Snoqualmie River	**Cedar River**	**Green River**	**White River**	**Totals**
Group Had Coolers Visible?					
Yes	2,129 (31.7%)	130 (8.9%)	311 (18.9%)	1 (7.7%)	2,563 (26.3%)
No	2,885 (42.9%)	1,096 (75.2%)	861 (52.4%)	7 (53.8%)	4,798 (49.1%)
Unsure	1,705 (25.4%)	226 (15.9%)	470 (28.6%)	5 (38.5%)	2,401 (24.6%)
Group Had Alcohol Visible?					
Yes	211 (3.1%)	21 (1.5%)	63 (3.8%)	0 (0.0%)	295 (3.0%)
No	3,327 (49.5%)	1,151 (78.3%)	985 (60.0%)	6 (46.2%)	5,406 (55.4%)
Unsure	3,181 (47.3%)	280 (20.2%)	594 (36.2%)	7 (53.8%)	4,062 (41.6%)
Group Had Fishing Equipment Visible?					
Yes	101 (1.5%)	23 (1.4%)	21 (1.3%)	0 (0.0%)	141 (1.4%)
No	5,539 (82.4%)	1,277 (87.9%)	1225 (74.6%)	10 (76.9%)	7,995 (81.9%)
Unsure	1,079 (16.1%)	152 (10.7%)	396 (24.1%)	3 (23.1%)	1,627 (16.7%)

Note: All numbers reported are direct counts.

Table 10. 2013 Field Observation Results – Countywide (Snoqualmie River system).	
Number of Observation Locations	14
Cumulative Days of Observation	98
Total Groups Recorded	1,474
Average Groups Recorded per Day	15.0
Total People Recorded	5,938
Adults (18+)	5,209 (87.7%)
Youth (12 to 17)	490 (8.3%)
Children (1 to 11)	239 (4.0%)
Male	3,261 (54.9%)
Female	2,677 (45.1%)
Average People Recorded per Day	60.6
People Wearing Life Vests	709 (11.9%)
Total Vessels Counted	4,602
Rafts	1,284 (27.9%)
Canoes	52 (1.1%)
Kayaks	202 (4.4%)
Inner tubes	2,840 (61.7%)
Other	224 (4.9%)
Vessels with Paddles	1,254 (27.2%)
Group Had Coolers Visible?	
Yes	602 (40.8%)
No	716 (48.6%)
Unsure	156 (10.6%)
Group Had Alcohol Visible?	
Yes	385 (26.1%)
No	976 (66.2%)
Unsure	113 (7.7%)
Group Had Fishing Equipment Visible?	
Yes	40 (2.7%)
No	1,026 (69.6%)
Unsure	408 (27.7%)

Note: All numbers reported are direct counts.

Table 11. Comparative Numbers of Groups and People Recorded per Day by Remote Cameras in 2013.		
Reach	**Average Number of Groups per Day of the Survey Period**	**Average Number of People per Day of the Survey Period**
Mainstem Snoqualmie River – Fall City above Bridge RM 34.7 RB Pointing Upstream and Pointing Downstream	35.0	139.7
Green River – Whitney Bridge RM 41.3 LB and 41.2 LB	6.6	21.8
Cedar River – Ricardi Reach RM 7.4 RB to Ron Regis Park RM 4.9 LB	4.2	10.8
Green River – Auburn-Black Diamond RM 33.4 LB to Isaac Evans Park RM 29.1 RB	2.3	7.0
Mainstem Snoqualmie River – Fall City below Bridge RM 34.1 RB and 33.9 RB	2.0	5.1
Cedar River – Rainbow Bend RM 11.4 RB to Belmondo 10.3 LB	0.3	0.8
Green River – Russell Woods Park RM 19.4 LB to Briscoe Park RM 15.9 RB	0.3	0.5
White River – Pacific City Park RM 6.1 RB and RM 5.9 RB	0.1	0.2

Note: All numbers reported are direct counts.

Table 12. 2013 Observations with Comparisons to 2010 Cedar River Field Observations and 2011 Lifejacket Monitoring.					
	2010 Cedar Field Observations	**2011 Lifejacket Monitoring**	**2013 Remote Cameras**	**2013 Aerial Surveys**	**2013 Snoqualmie Field Observations**
Days of Observation (weekend | weekday)[a]	49 (25 | 24)	6.5 (6.5 | 0)[b]	1,862 (1,289 | 573)	1 (1 | 0)[c]	98 (56 | 42)
Number of Groups | People	550 | 1960	130 | 438	9,826 | 35,171	125 | 597	1,474 | 5,938
Average Number of Groups | People per day of Observation	11 | 40	20 | 67	5 | 19	125 | 597	15 | 61
% adult | % youth | % children	73 | 18 | 9[d]	56 | 41 | 3[d]	94 | 4 | 2[d]	93 | 3 | 3[d]	88 | 8 | 4[d]
% male | % female	65 | 35		62 | 38	58 | 42	55 | 45
% tubes, mattresses | % rafts | % kayaks, pontoons, canoes, other	84 | 12 | 5	77 | 18 | 4	65 | 23 | 12	61 | 23 | 15	62 | 28 | 10
% vessels with oars or paddles	13	14	19	19	27
% wearing personal flotation devices (% adult | % youth | % children)	8 (5 | 2 | 39)[d]	30 (20 | 38 | 100)[e]	7 – 12% in Cedar River	15	12
% groups with alcohol visible	26		3 to 45[f]	35	26

Note: Numbers reported are direct counts; percentage groups may not add up to 100 due to rounding of numbers to the nearest whole number.

[a] Day defined as 8 hours in length; July 4 and Labor Day counted as weekend days.

[b] Observations taken on 13 separate days for 4 hours each day.

[c] Aerial surveys consisted of two approximately 4-hour periods.

[d] Adults defined as 18 and older.

[e] Adults defined as 22 and older.

[f] Range is due to uncertainty in observation.

Table 13. Estimated Total Number of Users on Each River from July 4, 2013, through September 2, 2013.

	Total River Users[a]	Average Users per Day	Average Users per Weekend Day	Average Users per Weekday
Cedar River	**1,064**			
Ricardi North	756	12	25	7
Regis	151	2	2	3
Belmondo[b]	109	2	3	1
Rainbow Bend	48	1	2	0
Green River	**2,360**			
Whitney Bridge Up	1,131	19	33	13
Auburn-Black Diamond	138	2	3	2
Fenster South	641	11	17	8
Isaac Evans North	368	6	12	3
Van Doren[b]	63	1	1	1
Briscoe South	19	0.3	0.2	0.3
White River	**16**			
White North	16	0.3	0.7	0.1
Snoqualmie	**11,198**			
Cherry Stand East	11,198	184	387	98

[a] Total number of users based on field camera observations between July 4, 2013, and September 2, 2013.

[b] Gaps in observed data were filled with multiple regression estimates of users using daily maximum temperature and/or weekday.

CONCLUSIONS AND RECOMMENDATIONS

Overall Conclusions Regarding Results

Considering that this current 2013 study and the 2010 Cedar River Study were conducted in different years, the methodologies vary, and the geographic locations of the field observations were taken on different rivers, the results from observations (as distinct from in-person interviews) with respect to the characteristics of casual on-river recreationists, in broad outline, are similar:

- Casual on-river recreationists are predominantly (75 percent or more) adults (18+ years of age).
- The majority (approximately 55 to 65 percent) of casual on-river recreationists are male.
- The majority (approximately 60 percent or more) of vessels used by casual on-river recreationists are inner tubes or inflatable mattresses.
- Most vessels (about 75 percent or more) used by casual on-river recreationists do not have oars or paddles.
- Most (85 percent or more) casual on-river recreationists do not wear personal flotation devices. Direct observational data from the 2010 Cedar River Study (Biedenweg and Akyuz 2011) and statistical inference from this current 2013 study indicates that, of the personal flotation devices that are worn, most are worn by children.
- Fewer than half of casual on-river recreationists were observed to have alcohol or coolers.

Additional overall conclusions resulting from the observations are the following:

- Aerial surveys, coupled with remote camera observations, indicate that the Snoqualmie River mainstem reach of about 3 river miles extending from just below Snoqualmie Falls to Fall City is, by far, the reach within the Snoqualmie River basin most heavily used by casual on-river recreationists. It is also, by far, the most heavily used river reach in King County.
- Field observations from this 2013 study, which are from locations in the Snoqualmie River basin, show a greater percentage of females within the sampled population of casual on-river recreationists than the percentage within the population sampled in the 2010 Cedar River Study (Table 3). Whether this difference reflects a countywide time-trend of greater female participation in casual on-river recreation or whether this reflects a time-independent difference between the characteristics of floaters on the Snoqualmie River compared to the Cedar River is unknown.

Conclusions Regarding Methods and Analysis

Statistical Validity

As described in the Survey Results and Analysis section, a number of statistically significant trends were identified based on the compiled data from this study. For example, temporal trends in river use and distinct patterns related to the presence of children, youths, life vests, and/or alcohol were all detected using data collected with the various survey methods in this study. This demonstrates that these methods and the associated numbers of observations generally produced a robust and statistically valid dataset for making inferences about recreational river use. However, the following limitations were noted when the data were used to evaluate specific hypotheses:

- The remote camera observation data were not helpful in making inferences about patterns related to the presence of children, youths, life vests, and/or alcohol because these details could not be reliably captured upon review of the associated films. However, because of the greater temporal resolution provided by the remote cameras, they were the most useful for detecting statistically significant temporal trends.
- The field observation data were most useful for detecting detailed patterns related to river recreational use. They were also marginally effective for detecting temporal patterns.
- Because aerial surveys were not replicated with sufficient frequency to provide some measure of the overall variability in river recreational use, the associated data were generally not useful for detecting statistically significant trends or patterns.
- A number of sites had very low usage for recreational river use in comparison to other sites. Where the number of users was consistently zero, statistically significant trends or patterns could not be detected.

Representativeness of Data Year-to-Year

The broad consistency between data sets obtained in this study and in the 2010 Cedar River Study (Biedenweg and Akyuz 2011) indicate that the results obtained from this 2013 study are generally representative of typical year-to-year conditions. However, variation from year to year is to be expected due to variations in factors influencing casual on-river recreation, such as yearly variations in weather and flow regimes. As an example of the variation in year-to-year weather, Figure D-23 in Appendix D shows that the number of days over 80 degrees F in the 17 years shown in the figure varied from a low of 10 days in 2001 to a high of 35 days in 2013.

The year-to-year variation is likely to be greatest (considered in terms of percentage change) for those rivers and river reaches where the level of use is low. For example, in a cumulative total of 168 days of observations from two cameras on the White River, 13 groups with 30 people were recorded. A change of only three more or three fewer groups would represent an approximately 25 percent change in group numbers for the White River, with a potential similar change in characteristics (e.g., life vest use).

Efficiency and Effectiveness

Field Observations vs. Remote Camera Observations

Field observations are more expensive and no more accurate than remote camera observations at collecting basic count data (e.g., numbers of floaters), but field observations are more accurate than remote camera observations in collecting data on floater characteristics (e.g., age and gender of floaters). Substantial interpretation was required in recording remote camera data on floater characteristics.

A potential downside to the use of remote cameras is vandalism. During this study, several of the installed cameras were vandalized. In all cases, cameras were installed on the largest trees available; but, in several cases, the trees that were available were not large enough to prevent climbing without a ladder.

Aerial Surveys

Aerial surveys are an efficient means of maximizing geographical coverage within a minimal time period. Aerial surveys are therefore a useful method for obtaining a snapshot, or near-instantaneous picture, of where use is occurring with the area covered by the aerial survey. However, obtaining a robust sample size through aerial surveys, which would require flying on many days, would be very expensive. Accuracy of the data obtained is potentially quite high, especially if high resolution video or still photos are used (see following discussion).

While videotaping was useful for documenting physical features of the river reaches surveyed, still photographs were a more efficient process, in terms of survey time required and the cost and complexity of equipment, for recording on-river recreational activity. Video camera images are relatively low resolution compared to those of still cameras. If the goal is to capture maximum detail, still photography is superior to videography. It is possible to record video in such a manner that the screen shots are sharper than the default mode. This would improve the ability of an analyst to gather data when stopping video at any given frame, but it would make the video difficult to watch. This was not attempted due to lack of time.

The still photos collected during the first round were taken while flying at “videotaping” speed and altitude. They were very sharp and detailed, and all the characteristics collected as data could be easily discerned. During the second round of aerial surveys, only still photography was performed. This allowed the helicopters to fly faster, but flying faster required flying higher for safety (because it is more difficult to see power lines at high speed). Flying higher resulted in photographs that had a larger scale and, consequently, less detail than photographs taken from the slower first flights in which videotaping occurred. This situation could be remedied by picking a middle speed and flying a bit lower or, possibly, by photographing with a longer lens (300 to 500 mm instead of 70 to 200 mm).

Recommendations

Survey Methods for Future River Recreation Data Gathering

Selection of Survey Method

The best survey method—aerial, remote camera, or field—to use in any future survey of on-river recreational use would depend on the type of data sought. If the intent is to obtain accurate information regarding the characteristics of floaters (e.g., age, gender, use of alcohol), field observations would be the best method. If the intent is to obtain accurate information about the numbers of floaters, but it is less important to obtain accurate information regarding the characteristics of these floaters, then remote cameras would be the least expensive method. Field observations can collect count data that is about as accurate as the count data collected by remote cameras, but field observations are a much more labor-intensive, and therefore much more expensive, means of obtaining large robust sets of count data.

Field Observations

To reduce the costs of field observations, future surveys of casual on-river recreationists could begin as late as 2:00 p.m. and extend to 6:00 p.m., and most users would be observed. At the busiest sites (e.g., the SR 202 Bridge), a camera would be useful to photograph large groups, with the photographs analyzed in the office later.

Remote Cameras

Additional time should be spent in preparing the remote camera sites and installing cameras. For example, it would be worth investing more time in reconnaissance to find sites with large trees without climbable branches. More effort could be expended on camouflage at locations where no large trees are available. A different tactic could be used, such as using more easily hidden "security" cameras instead of wildlife cameras; however, because security cameras are comparatively low resolution, their use may reduce the type and/or accuracy of data collected. Additional time could be expended to remove branches from the camera view, as waving branches are highly distracting when reviewing the films. Sun position should be carefully assessed to try to avoid direct sun, lens flare, and glare, which make some parts of the videos difficult to interpret. In some locations, that would require switching sides of the river. Whenever possible, cameras should be pointed at slack water. That would result in videos that are easier to review because of lack of water turbulence and because each vessel appears in more photos since it passes through the field of view more slowly, increasing the chances that a good viewing angle will be captured and that maximum information will be obtained.

Aerial Surveys

If aerial surveys are used in the future to obtain an instantaneous record of use on the county's rivers, use of still photography would be recommended for data acquisition rather than videotaping.

Interviews

In-person interviews can be very useful in collecting data on attitudes and perceptions that cannot be collected by "hands-off" observations. In-person interviews would best be conducted using questionnaires involving fewer questions than were included in this 2013 study's interviews. Rather than encompassing a broad range of issues, the questions could focus on one or two specific issues. Ideally, the interviewer would be able to explain to the interviewee how answers to the focused questions would help the County take actions that would benefit in-river recreation. It appeared that the interview set of questions that were used in this study left many interviewees with the impression that the County was collecting information on recreational use without a clear beneficial outcome for the interviewee, so some interviewees felt as though the interview was a governmental imposition.

If the interviews must be read out loud, they should be shorter. Long interviews, such as the one that was used in this 2013 study, should be hard-copy questionnaires handed to the interviewee to fill out. As was done in the 2010 Cedar River Study, an appropriate gift, such as a safety whistle or a discount coupon for a personal flotation device, could be provided to interviewees in exchange for their participation.

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APPENDIX A

Field Observation and Remote Camera Locations and Descriptions

Remote Camera Locations

SNOQUALMIE RIVER

Location

Fall City Above Bridge RM 34.7 RB (Pointing Upstream) (Latitude: 47°34′4.18″N, Longitude: 121°52′33.45″W).

Description

Camera Quality

- **Demographic count accuracy:** Glare from the sun often interfered with an accurate count of total persons, gender, and age. In the late morning/early afternoon (11 a.m. to 3 p.m.), demographic counts were more accurate due to sun positioning, smaller group sizes, and less frequent observations. When in doubt, half of each group was recorded as men. For odd total numbers, the men count was rounded up. If indeterminable, ages were recorded as adult.
- **Vessel count accuracy:** Glare from sun and large group sizes often interfered with an accurate count of total vessels and type. In late morning/early afternoon (11 a.m. to 3 p.m.), vessel counts were more accurate due to sun position, smaller group sizes, and infrequent observations.
- **Alcohol visibility:** Due to the camera distance from the river and glare, presence of alcohol was assumed based on group size, arm positioning, coolers, and raucousness.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddle visibility was dependent on whether paddles were actively being used as well as the orientation of the paddle with respect to the camera angle.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 10 to 30 frames. Glare from the sun was the main issue with this camera orientation.

Fall City Above Bridge RM 34.7 RB (Pointing Upstream)

Location

Fall City Above Bridge RM 34.7 RB (Pointing Downstream) (Latitude: 47°34′4.18″N, Longitude: 121°52′33.45″W).

Description

Camera Quality

- **Demographic count accuracy:** Glare from the sun often interfered with an accurate count of total persons, gender, and age. In the late morning/early afternoon (11 a.m. to 3 p.m.), demographic counts were more accurate due to sun positioning, smaller group sizes, and less frequent observations. When in doubt, half of each group was recorded as men. For odd total numbers, the men count was rounded up. If indeterminable, ages were recorded as adult.
- **Vessel count accuracy:** Glare from sun and large group sizes often interfered with an accurate count of total vessels and type. In late morning/early afternoon (11 a.m. to 3 p.m.), vessel counts were more accurate due to sun position, smaller group sizes, and infrequent observations.
- **Alcohol visibility:** Due to the camera distance from the river and glare, presence of alcohol was assumed based on group size, arm positioning, coolers, and raucousness.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddle visibility was dependent on whether paddles were actively being used as well as the orientation of the paddle with respect to the camera angle.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 10 to 30 frames. Glare from the sun was the main issue with this camera orientation.

Fall City Above Bridge RM 34.7 RB (Pointing Downstream)

Location

Fall City Below Bridge RM 34.1 RB (Latitude: 47°34′11.41″N, Longitude: 121°53′32.99″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera resolution, the presence of alcohol was assumed based on group size, arm positioning, coolers, and raucousness, rather than the visual indication of a can or bottle, since this resolution was not available in most cases.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddle visibility was dependent on whether they were actively being used and the orientation of the paddle with respect to the camera angle.

Camera Placement

The river composed approximately one-fourth of the camera view, which increased pixilation when zooming in to record recreational user attributes. Most vessels were visible for approximately 5 to 15 frames.

Fall City Below Bridge RM 34.1 RB

Location

Fall City Below Bridge RM 33.9 RB (Latitude: 47°34′11.41″N, Longitude: 121°53′32.99″W).

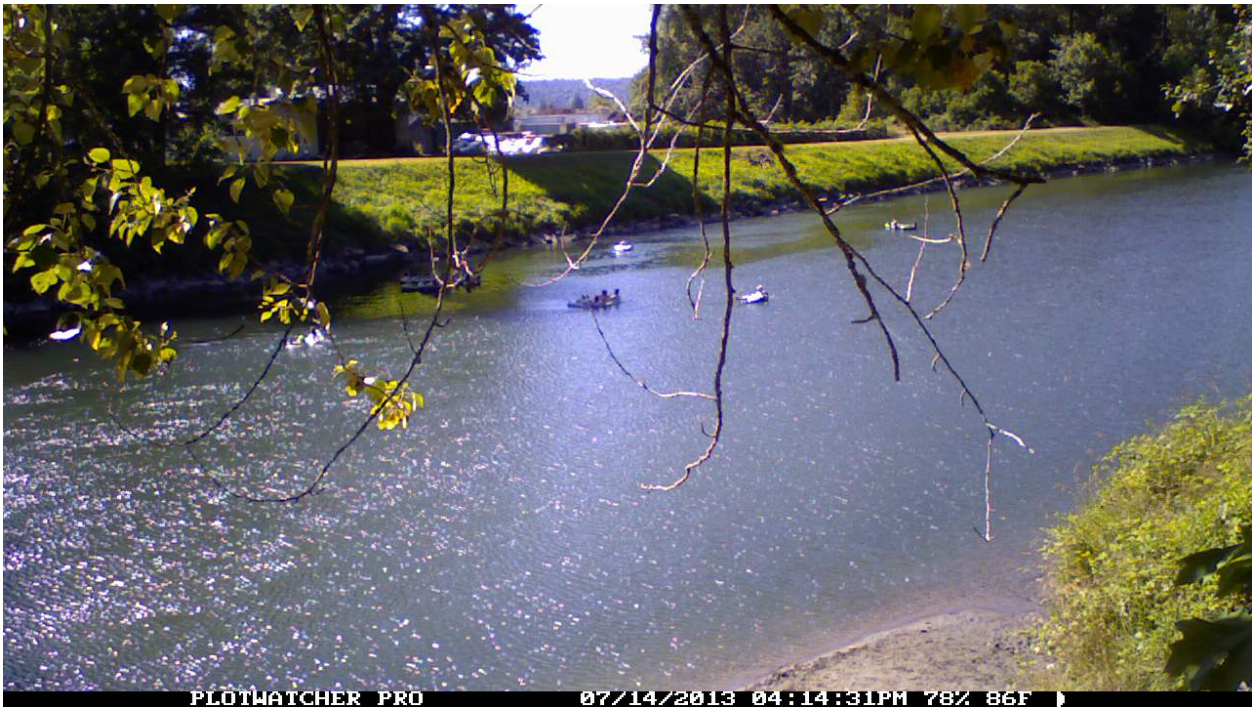
Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera resolution at this location, alcohol presence was difficult to determine.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 5 to 10 frames. The tree branches obstructed the view in some cases.



Fall City Below Bridge RM 33.9 RB

CEDAR RIVER

Location

Rainbow Bend RM 11.4 RB (Latitude: 47°26′24.62″N Longitude: 122°3′53.21″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was near the river. Most vessels were visible for more than 20 frames.

Rainbow Bend RM 11.4 RB

Location

Belmondo RM 10.3 LB (Latitude: 47°27′0.68″N Longitude: 122°4′24.20″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was near the river. Most vessels were visible for more than 20 frames.

Belmondo RM 10.3 LB

Location

Ricardi Reach RM 7.4 RB (Latitude: 47°27′55.56″N, Longitude: 122°6′16.51″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for more than 20 frames.

Ricardi Reach RM 7.4 RB

Location

Ricardi Reach RM 7.3 RB (Latitude: 47°27′58.02″N, Longitude: 122°6′28.51″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for more than 20 frames.

Ricardi Reach RM 7.3 RB

Location

Elliot Reach RM 5.6 RB (Latitude: 47°28′4.77″N, Longitude: 122°8′14.98″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 1 to 5 frames, which made some observations difficult to record.

Elliot Reach RM 5.6 LB

Location

Ron Regis Park RM 4.9 LB (Latitude: 47°28′9.22″N, Longitude: 122°8′55.10″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to log jams upstream, many recreational users put in outside of the camera frame. Any person/group of people carrying vessels out of the downstream end of the frame were assumed to be putting in.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Since most people put in in this location, alcohol was typically not visible if present.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was near the river, but most users put in downstream of the camera view and pedestrians were only in view for approximately 5 frames. Glare affected visibility sometimes.

Ron Regis Park RM 4.9 LB

GREEN RIVER

Whitney Bridge RM 41.3 LB (Latitude: 47°16′55.74″N, Longitude: 122°3′13.10″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for more than 20 frames.

Whitney Bridge RM 41.3 LB Remote Camera Location

Location

Whitney Bridge RM 41.2 LB (Latitude: 47°16′57.02″N, Longitude: 122°3′17.00″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for no more than 5 frames.

Whitney Bridge RM 41.2 LB Remote Camera Location

Location

Auburn-Black Diamond Road RM 33.4 LB (Latitude: 47°18′7.28″N, Longitude: 122°10′32.60″W).

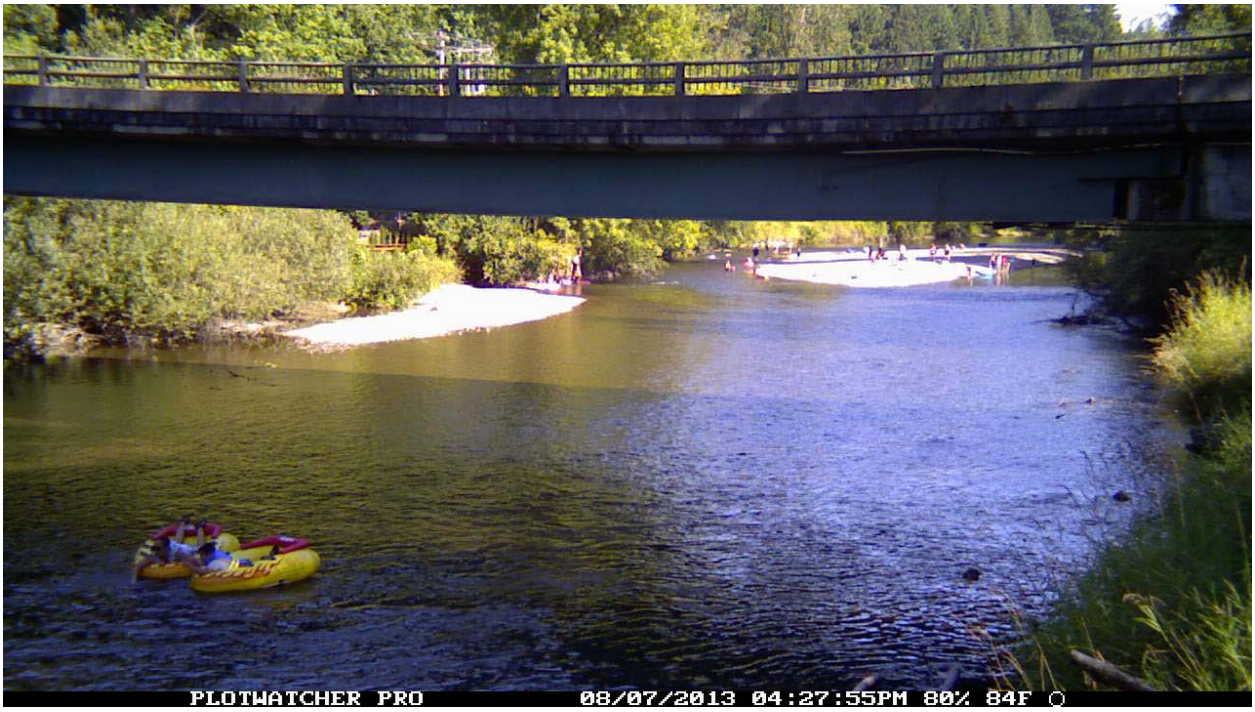
Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for more than 20 frames.



Auburn-Black Diamond Road RM 33.4 LB Remote Camera Location

Location

Fenster Property RM 32.0 LB (Latitude: 47°18′15.89″N, Longitude: 122°11′58.29″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for more than 20 frames.

Fenster Property RM 32.0 LB Remote Camera Location

Location

Fenster Property RM 31.9 LB (Latitude: 47°18′16.57″N, Longitude: 122°11′59.01″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 10 to 15 frames.

Fenster Property North RM 31.9 LB

Location

Isaac Evans Park RM 29.3 RB (Latitude: 47°19′57.00″N, Longitude: 122°12′48.18″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 1 to 5 frames, which made some observations difficult to record. Construction occurred on the left bank for most of the observation period. The first observation period data was lost to a camera error.

Isaac Evans Park RM 29.3 RB Remote Camera Location

Location

Isaac Evans Park RM 29.1 RB (Latitude: 47°20′5.93″N, Longitude: 122°12′37.67″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera distance from the river and glare, the presence of alcohol was assumed based on group size, arm positioning, coolers, and raucousness, rather than the visual indication of a can or bottle, since this resolution was not available in most cases.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 5 to 10 frames. Glare often obscured portions of the river after 5 p.m. Construction occurred on the left bank for most of the observation period.

Isaac Evans Park RM 29.1 RB Remote Camera Location

Location

Russell Woods Park RM 19.4 LB (Latitude: 47°23′41.18″N, Longitude: 122°16′28.86″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 1 to 5 frames, which made some observations difficult to catch.

Russell Woods Park RM 19.4 LB Remote Camera Location

Location

Van Doren's Landing Park RM 18.5 LB (Latitude: 47°24′21.77″N, Longitude: 122°16′26.66″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 5 to 10 frames. No data are available from the last observation period (beginning August 23) because the camera was stolen.

Van Doren's Landing Park RM 18.5 LB

Location

Briscoe Park RM 16.5 RB (Latitude: 47°25′43.13″N, Longitude: 122°15′52.92″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera resolution at this location, alcohol presence was difficult to determine.
- **Life jacket visibility:** Life jackets were generally visible if brightly colored.
- **Paddle visibility:** Due to the camera resolution at this location, paddles were difficult to observe.

Camera Placement

The river comprised approximately only one-sixth of the camera view, which increased pixilation when zooming in and made it difficult to observe recreational users. Each vessel was visible for approximately 1 to 5 frames, which made many observations difficult to record.

Briscoe Park RM 16.5 RB

Location

Briscoe Park RM 15.9 RB (47°25′58.27″N, Longitude: 122°15′43.18″W).

Description

Camera Quality

- **Demographic count accuracy:** Demographic information was generally visible.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Alcohol was generally visible if in possession.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river, and most vessels were visible for approximately 1 to 5 frames, which made some observations difficult to catch. A spider covered the camera for portions of the viewing period, and glare sometimes obscured portions of the river after 5:00 p.m. For Round 3 (August 23 to September 19), the camera was moved upstream, which reduced visibility of the river.

Briscoe Park RM 15.9 RB Remote Camera Location

White River

Location

Pacific City Park RM 6.1 RB (Latitude: 47°15′51.53″N, Longitude: 122°14′4.37″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera resolution at this location, alcohol presence was difficult to determine.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The placement of this camera was centered and near the river. Most vessels were visible for approximately 1 to 10 frames.

Pacific City Park RM 6.1 RB

Location

Pacific City Park RM 5.9 RB (Latitude: 47°15′45.15″N, Longitude: 122°14′10.97″W).

Description

Camera Quality

- **Demographic count accuracy:** Due to the camera resolution at this location, gender and age were difficult to determine.
- **Vessel count accuracy:** Vessel count and types were generally visible.
- **Alcohol visibility:** Due to the camera distance from the river and glare, the presence of alcohol was assumed based on group size, arm positioning, coolers, and raucousness, rather than the visual indication of a can or bottle, since this resolution was not available in most cases.
- **Life jacket visibility:** Most lifejackets were visible if brightly colored.
- **Paddle visibility:** Paddles were generally visible.

Camera Placement

The river composed approximately one-fourth of the camera frame for most of the observation period. In the first round of camera observations (June 26 to July 23), the side channel in the foreground was activated, but in the following observation period (July 23 to August 20), rock strips prevented floating traffic through the side channel. In the third observation period (August 20 to September 19), the camera was moved downstream to display more of the river. Most vessels were visible for approximately 1 to 10 frames, which made some observations difficult to record.

Pacific City Park RM 5.9 RB

Field Observation Locations

Location

436th Avenue SE Bridge (Latitude: 47°27′58.82″N, Longitude: 121°45′31.92″W).

Description

The 436th Avenue SE Bridge observation site is located on the left bank of the South Fork Snoqualmie River at RM 6.0. The site is accessed by a trail on the southwest end of the bridge. The observation location was situated on a gravel bar with a view upstream and downstream of approximately 300 meters. The water was shallow in reaches, making it difficult for anything larger than a kayak to pass without carrying the vessel at times, especially by August.

436th Avenue SE Bridge Observation Location

Location

SR 202 (Bendigo Boulevard) Bridge (Latitude: 47°29′33.56″N, Longitude: 121°47′22.45″W).

Description

The SR 202 (Bendigo Boulevard) observation site is located is located on the right bank of the South Fork Snoqualmie River at RM 2.9. Field observations were taken near the Gardner-Weeks Park Bridge in the city of North Bend. Due to the obscured visibility from the road and park, homeless people slept and lived under the bridge. This observation location generally seemed to be an area that detracted families from swimming and floating. The river access trails were steep and not inviting as a put-in/take-out location. Most of the observations at this location were of kayakers and well-equipped recreational users.

SR 202 (Bendigo Boulevard) Bridge Observation Location

Location

SE Mount Si Road (Tanner put-in) (Latitude: 47°28′46.77″N, Longitude: 121°44′18.52″W).

Description

This field observation site is located on the left bank of the Middle Fork Snoqualmie River at RM 4.4. Access to the site is on SE Mount Si Road where the gravel path is gated at SE Tanner Road. The site can be reached on foot. At the site, the river is flanked by a rocky shoreline that stretches from bank to bank and extends at least 200 feet upstream. The narrow channel, large rocks in the river, and change in water surface elevation also produce faster rapids upstream of the put-in site.

SE Mount Si Road (Tanner Put-in) Observation Location

Location

SE 114th Street (Blue Hole) (Latitude: 47°29′51.22″N, Longitude: 121°45′50.39″W).

Description

The SE 114th Street (Blue Hole) observation site is located on the left bank of the Middle Fork Snoqualmie River at RM 2.0. The site is accessed by a trail at the SE 114th Street dead end. This location mostly attracts swimmers because there is a pool and park located at the meander bend. Many recreational users jumped off of the rocks on the right bank of the pool. Upstream and downstream of the pool were areas of shallow rapids with boulders.

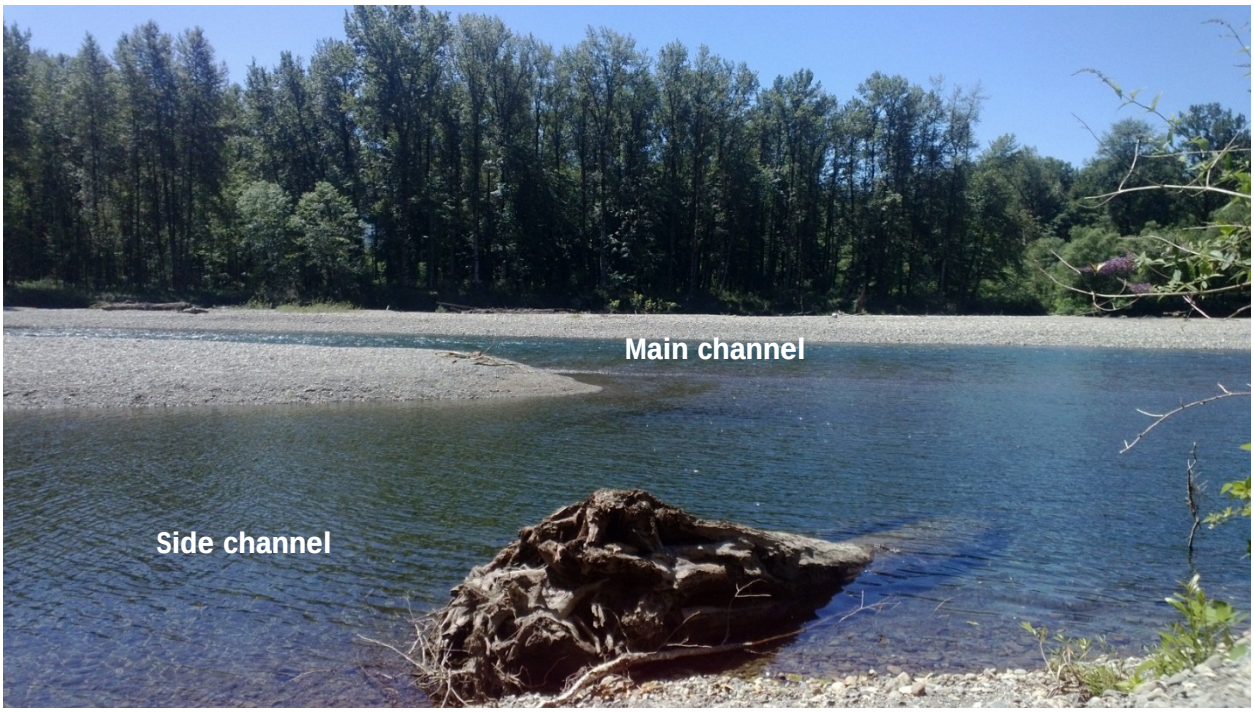
SE 114th Street (Blue Hole) Observation Location

Location

Three Forks Park (Latitude: 47°31′22.45″N, Longitude: 121°46′51.37″W).

Description

The Three Forks Park observation site is located on the right bank of the Mainstem Snoqualmie River (above the Falls) at RM 42.2. The site is accessed by a short trail that is marked by a sign and turnout alongside SE Reinig Road. The site layout consisted of a side channel and a main channel as shown in the photo below. The side channel received a moderate volume of recreational users (mostly swimmers), but these users were stationary and did not travel beyond the side channel. The side channel was a prime location for families because the waters were tranquil and shallow. The main channel was fast, cobbled, and shallow. Recreational users in the main channel generally put in and took out in the same 50-meter stretch and would walk up the mid-channel sand bar between runs. The people and dogs that swam and floated in the main channel generally struggled against the current, which is why this region did not receive much through floating traffic.



Three Forks Park Observation Location

Location

Snoqualmie Trail Bridge (SE Reinig Road) (Latitude: 47°31′47.24″N, Longitude: 121°48′24.58″W).

Description

The Snoqualmie Trail Bridge (SE Reinig Road) observation site is located on the right bank of the Upper Mainstem Snoqualmie River (above the Falls) at RM 40.6. The site is accessed by a short trail that leads out onto a small public beach at the intersection of SE Reinig Road and 396th Drive SE in Snoqualmie, Washington. The observation location was situated on the beach approximately 100 meters upstream of the Snoqualmie Trail Bridge, with a view upstream and downstream of approximately 200 meters. The water was slow in this reach and for a long distance up- and downstream; no rapids were visible. The beach was a popular gathering spot for locals.

Snoqualmie Trail Bridge (SE Reinig Road) Observation Location

Location

Plum Creek Boat Ramp (Latitude: 47°33′5.00″N, Longitude: 121°51′1.37″W).

Description

The observation site is on the right bank of the Mainstem Snoqualmie River (from Falls to Falls City) at RM 37.3. The Plum Creek Boat Ramp can be accessed from a gravel parking lot on SE Fish Hatchery Road in Carnation. Parking at the site requires a Discover Pass and is managed by the Washington Department of Fish and Wildlife. A boat ramp and pathways are available to reach the shore. At the bank, a short stretch of beach provides space for visitors to use the River.

Plum Creek Boat Ramp Observation Location

Location

Fall City Boat Ramp (Latitude: 47°34′04.92″N, Longitude: 121°52′56.79″W).

Description

The Fall City Boat Ramp (also called Zurfleuh Boat Launch) observation site is located on the left bank of the mainstem Snoqualmie River (Falls to Falls City) at RM 34.4. Field observations were taken at the end of the boat ramp road, which goes from the gravel parking lot down to the river bank. Few boaters launched or took out from this location, but many floated past. A quarter mile downstream from this observation location is the SR 202 Bridge, where the majority of floaters exit the river. Between the boat ramp and the bridge is a large river bar at the confluence of the Raging River coming into the Snoqualmie River. Many floaters exit at this river bar, which may lead to some confusion over whether the floaters are exiting at the boat launch or the SR 202 Bridge. However, upon exiting, most people walk toward the bridge. The river bar is also popular with families and groups that are not floaters.

Fall City Boat Ramp Observation Location

Location

Fall City (SR 202) Bridge (Latitude: 47°34′5.26″N, Longitude: 121°53′15.46″W).

Description

The Fall City (SR 202) Bridge observation site is located on the left and right banks of the mainstem Snoqualmie River (from Falls to Falls City) at RM 34.2. Field observations were typically taken from the left bank, which was the primary take-out location for recreational users who would exit on a small trail to the parking lot on the west side of the south end of the SR 202 bridge. The SR 202 bridge was the primary take-out location for recreational users, in general, with very few people continuing beyond this location. In attempts to regain local business parking, a local group created signage that directed recreational users to take out on the right bank and use the free public parking at the Fall City Community Park. A large sign was posted near the SR 202 bridge, in the free parking lot, and at the new take-out location. The parking lot on the left bank was correspondingly closed. The intent of this change was to keep the left bank open to locals and to encourage tourists to use the right bank. Once this change was enacted in mid-August, 2013, about half of the recreational users took out on each bank.

The left bank was the primary location for swimmers as well, who were present consistently throughout the day. The mornings (11 a.m. to 3 p.m.) tended to have fewer recreational users, while the afternoons (3 p.m. to 7 p.m.) were consistently crowded with high activity and drinking. With several large groups of 15 to 30 people floating down at once in a continuous stream, it was often difficult to get an accurate count of people, vessels, and equipment (paddles, lifejackets). In the afternoon, it was difficult to survey the recreational users for their put-in/take-out location since there was a continuous stream of users, though most of the users were taking out at this location. Alcohol was not always readily visible on the water, but it was a common sight to see rafts full of cans when the groups took out.

Fall City (SR 202) Bridge Observation Location

Location

Aldair Levee (Latitude: 47°34′54.49″N, Longitude: 121°54′24.47″W).

Description

The Aldair Levee observation site is located on the left bank of the mainstem Snoqualmie River (from Falls City to Carnation) at RM 32.7. The site is accessed by a driveway that leads out onto the levee at the intersection of SE 31st Street and 324th Avenue SE in Fall City, Washington. The observation location was situated on the levee with a view upstream and downstream of approximately 300 meters. The water was slow in this reach and, for a long distance up- and downstream, no rapids were visible. It is difficult to access the levee from the river, so boaters do not put in or take out at the site.

Aldair Levee Observation Location

Location

Neal Road Boat Ramp (Latitude: 47°35′46.31″N, Longitude: 121°54′49.82″W).

Description

The Neal Road Boat Ramp observation site is located on the right bank of the mainstem Snoqualmie River (Falls City to Carnation) at RM 31.0. Field observations were taken at the boat launch located at the end of Neal Road SE. This location was surrounded by agricultural fields, farmland, and private lands.

Neal Road Boat Ramp Observation Location

Location

Tolt RM 1.8 to 1.9 (Latitude: 47°38′36.18″N, Longitude: 121°53′31.95″W).

Description

This field observation site is located on the right bank of Tolt River at RM 1.8 to 1.9. Access to the site is by foot from 336th Ave NE in Carnation. At the end of the drive behind the single-family residences is a wooded area, where an unmarked dirt trail in the southwest direction leads to the Tolt RM 1.8 river bar. The site is exposed where river flows have carved a smooth beach at the river bend. The river water surface elevation is shallow, allowing visitors to easily walk in the channel.

Tolt RM 1.8 to 1.9 Observation Location

Location

Tolt RM 0.5 (Latitude: 47°38′16.46″N, Longitude: 121°54′59.70″W).

Description

The Tolt RM 0.5 observation site is located on the right bank of the Tolt River at RM 0.5. The observation location is accessed at the first west exit on SR 203/Tolt Avenue, north of the Tolt River bridge. This observation location is the sign-designated location to take out due to log jams present downstream. The recreational users at this site were primarily swimmers and families.

Tolt RM 0.5 Observation Location

Location

Tolt-Snoqualmie Confluence (Latitude: 47°38′24.79″N, Longitude: 121°55′36.07″W).

Description

The Tolt-Snoqualmie Confluence observation site is located on the right bank of the Tolt River immediately upstream of its confluence with the mainstem Snoqualmie River at RM 0.0. The observation location is accessed through the Tolt-MacDonald Park. The recreational users at this location can be divided into two categories. The first category was campers/locals, who mostly swam in the Snoqualmie River along the park shore or floated in inner tubes around the bend from the Tolt into the Snoqualmie River. Once they reached the Snoqualmie River, these floaters typically walked along shore trails back to the Tolt River and refloated the same short stretch of river. The camper demographic mostly consisted of families of varying ages. The typical take-out for other recreational users that started on the Snoqualmie River were on the right and left banks of the Snoqualmie River in the Tolt-MacDonald park/campground. The second category was boat launch users upstream on the Snoqualmie River. These users' vessels mostly consisted of motor boats, kayaks, and canoes. These users would start and end their trip at the boat launch. In general, most of the observations at this location occurred on the Snoqualmie River.

Tolt-Snoqualmie Confluence Observation Location

APPENDIX B

Field Observation and Interview Forms

LOCATION:	
OBSERVER:	
DATE:	

OBSERVATION #		**OBS-1**	**OBS-2**	**OBS-3**	**OBS-4**	**OBS-5**	**OBS-6**	**OBS-7**
Demographic Counts	**Total People in Group**							
	Adults (18+)							
	Youth (12 TO 17)							
	Children (1 TO 11)							
	Males							
Vessel Counts	**People Wearing Life Vests**							
	Rubber Rafts							
	Canoes							
	Kayaks							
	Inner Tubes							
	Other Vessels							
	Of all vessels observed, how many have paddles or oars?							
Questions to Answer Based on Observations	**Which river did this observation occur on?** (Applies to Tolt/Snoqualmie Confluence Site Only)							
	Does the group have coolers?							
	Is any alcohol visible?							
	Does the group have fishing equipment?							
Questions to Answer Based on Asking Boaters	**Where did the group put in?**							
	If other, please specify.							
	Where does the group intend to take out?							
	If other, please specify.							
Notes								
Time Stamp								

King County River Use Survey (Snoqualmie system)

1. Please indicate how often you do the following types of river recreation?

	Number of years you have been doing this…		Number of days in a typical year you do this…	
	On any river	On this river	On any river	On this river
Boating				
Canoeing / kayaking				
Floating / Tubing				
Fishing				
Swimming / Wading				

2. Are there other river reaches you regularly float / boat? (if so, which_____)

3. How many people were in your boat/vessel today? _____ people

4. How many people were in your group today? _____ adults (18+) _____ young adults (12-17) _____ children (under 12)

5. How many other boats/tubes were in your group today? _____ boats/tubes

6. What time today did you put-in and where? Time: _____ at _____

7. About how many total hours did you spend on the river today? About _____ hour(s) Note activity _____

8. Where do you live (please write your zip code)? |_|_|_|_|_| or country _____

9. Did you wear a PFD (life jacket) today?
   1. Yes
   2. No → Please check any reason why you chose not to wear a PFD:
      - ❑ It's too hot
      - ❑ PFDs are uncomfortable
      - ❑ I'm a strong swimmer
      - ❑ I'm a skilled boater
      - ❑ I don't have one
      - ❑ They are too expensive
      - ❑ The river is not hazardous at this flow
      - ❑ The river is not hazardous at all
      - ❑ Bring one / don't wear it
      - ❑ Forgot it

10. Please rate the ability of yourself and the least skilled person in your group… *(Circle one number for each row)*

	Novice or beginner	Intermediate	Skilled	Expert or highly skilled
Your boating / tubing ability	1	2	3	4
Your swimming ability	1	2	3	4
The group's least skilled boating / tubing ability	1	2	3	4
The group's least skilled swimming ability	1	2	3	4

11. Prior to this trip did you obtain information about river conditions (e.g., difficulty, flows, temperature and potential hazards)?
   1. No
   2. Yes →Please check any source who provided this information
      - ❑ Friends or family (word of mouth)
      - ❑ A river guidebook
      - ❑ The King County website
      - ❑ Another internet website (please specify if you can) _____
      - ❑ Other (please specify) _____

12. Please rate your perception of the relative hazards you encountered while boating today? *(Circle one number for each row)*

	Less hazardous				More hazardous	Don't know
Fast water	1	2	3	4	5	X
Cold water	1	2	3	4	5	X
Rocks in rapids	1	2	3	4	5	X
Deep pools	1	2	3	4	5	X
Slippery or undercut access points / shore areas	1	2	3	4	5	X
Fallen trees in river	1	2	3	4	5	X
Intoxication	1	2	3	4	5	X
Other users	1	2	3	4	5	X
A mix of the hazards listed above	1	2	3	4	5	X
Other (please specify):						

13. In general, do you support or oppose the following?
(Circle one number for each row)

	Strongly oppose	Slightly oppose	Neutral	Slightly support	Strongly support	Don't know
Develop website with information about hazards	1	2	3	4	5	X
Information provided about hazards ***via social media***	1	2	3	4	5	X
Increase ***hazard information*** at put-ins	1	2	3	4	5	X
On-river ***warning signs*** upstream of specific hazards	1	2	3	4	5	X
On-river ***direction signs*** ("go left") for specific hazards	1	2	3	4	5	X
Require boaters/tubers to ***wear life jackets*** (PFDs)	1	2	3	4	5	X
*"**No alcohol**"* regulations for all boaters	1	2	3	4	5	X
Close river segments at flows that increase hazards	1	2	3	4	5	X

Observational variables – for surveyor use only – recorded in separate log:

Day ❑Mon ❑Tue ❑Wed ❑Thu ❑Fri ❑Sat ❑Sun and date

Time of interview _____ _____ (Use military time – to closest half hour).

Location ❑ ❑ ❑ ❑

Number of boats
__ Multi-chamber raft __ Canoe __ Covered tube (manufactured)
__ Vinyl/cheap raft __ IK __ Black tire inner-tube
__ Cataraft __ Kayak __ Other (please specify: _____)

Number of boats with paddles _____

Weather ❑Sunny ❑Partly sunny ❑Partly cloudy ❑Cloudy ❑Off/on rain ❑ Rain ❑ Mixed

Flow _____ cfs at _____

Evidence of alcohol ❑ visible intoxicated ❑ visible and open ❑ potential/subtle use ❑ no evidence

People and PFDs
___ Adults (18 and over) with ___ wearing PFDs
___ Young adults (12-17) with ___ wearing PFDs
___ Children (under 12) with ___ wearing PFDs

Other visible gear: ___ dry bag with dry clothes ___ whistle ___ first aid kit ___ appropriate footwear?

King County River Use Survey (White River)

1. Please indicate how often you do the following types of river recreation?

	Number of years you have been doing this…		Number of days in a typical year you do this…	
	On any river	On this river	On any river	On this river
Boating				
Canoeing / kayaking				
Floating / Tubing				
Fishing				
Swimming / Wading				

2. Are there other river reaches you regularly float / boat? (if so, which_____)

3. How many people were in your boat/vessel today? _____ people

4. How many people were in your group today? _____ adults _____ young adults (12-17) _____ children (under 12)

5. How many other boats/tubes were in your group today? _____ boats/tubes

6. What time today did you put-in and where? Time: _____ at _____

7. About how many total hours did you spend on the river today? About _____ hour(s) Note activity _____

8. Where do you live (please write your zip code)? |_|_|_|_|_| or country _____

9. Did you wear a PFD (life jacket) today?
   1. Yes
   2. No → Please check any reason why you chose not to wear a PFD:
      - ❑ It's too hot
      - ❑ PFDs are uncomfortable
      - ❑ I'm a strong swimmer
      - ❑ I'm a skilled boater
      - ❑ I don't have one
      - ❑ They are too expensive
      - ❑ The river is not hazardous at this flow
      - ❑ The river is not hazardous at all
      - ❑ Bring one / don't wear it
      - ❑ Forgot it

10. Please rate the ability of yourself and the least skilled person in your group… *(Circle one number for each row)*

	Novice or beginner	Intermediate	Skilled	Expert or highly skilled
Your boating / tubing ability	1	2	3	4
Your swimming ability	1	2	3	4
The group's least skilled boating / tubing ability	1	2	3	4
The group's least skilled swimming ability	1	2	3	4

11. Prior to this trip did you obtain information about river conditions (e.g., difficulty, flows, temperature and potential hazards)?
   1. No
   2. Yes →Please check any source who provided this information
      - ❑ Friends or family (word of mouth)
      - ❑ A river guidebook
      - ❑ The King County website
      - ❑ Another internet website (please specify if you can) _____
      - ❑ Other (please specify) _____

12. Please rate your perception of the relative hazards you encountered while boating today? *(Circle one number for each row)*

	Less hazardous				More hazardous	Don't know
Fast water	1	2	3	4	5	X
Cold water	1	2	3	4	5	X
Water cloudiness	1	2	3	4	5	X
Rocks in rapids	1	2	3	4	5	X
Deep pools	1	2	3	4	5	X
Slippery or undercut access points / shore areas	1	2	3	4	5	X
Fallen trees in river	1	2	3	4	5	X
Intoxication	1	2	3	4	5	X
Other users	1	2	3	4	5	X
A mix of the hazards listed above	1	2	3	4	5	X
Other (please specify):						

13. In general, do you support or oppose the following?
(Circle one number for each row)

	Strongly oppose	Slightly oppose	Neutral	Slightly support	Strongly support	Don't know
Develop website with information about hazards	1	2	3	4	5	X
Information provided about hazards ***via social media***	1	2	3	4	5	X
Increase ***hazard information*** at put-ins	1	2	3	4	5	X
On-river ***warning signs*** upstream of specific hazards	1	2	3	4	5	X
On-river ***direction signs*** ("go left") for specific hazards	1	2	3	4	5	X
Require boaters/tubers to ***wear life jackets*** (PFDs)	1	2	3	4	5	X
*"**No alcohol**"* regulations for all boaters	1	2	3	4	5	X
Close river segments at flows that increase hazards	1	2	3	4	5	X

Observational variables – for surveyor use only – recorded in separate log:

Day ❑Mon ❑Tue ❑Wed ❑Thu ❑Fri ❑Sat ❑Sun and date

Time of interview _____ _____ (Use military time – to closest half hour).

Location ❑ ❑ ❑ ❑

Number of boats
__ Multi-chamber raft __ Canoe __ Covered tube (manufactured)
__ Vinyl/cheap raft __ IK __ Black tire inner-tube
__ Cataraft __ Kayak __ Other (please specify: _____)

Number of boats with paddles _____

Weather ❑Sunny ❑Partly sunny ❑Partly cloudy ❑Cloudy ❑Off/on rain ❑ Rain ❑ Mixed

Flow _____ cfs at _____

Evidence of alcohol ❑ visible intoxicated ❑ visible and open ❑ potential/subtle use ❑ no evidence

People and PFDs
___ Adults (18 and over) with ___ wearing PFDs
___ Young adults (13-17) with ___ wearing PFDs
___ Children (under 13) with ___ wearing PFDs

Other visible gear: ___ dry bag with dry clothes ___ whistle ___ first aid kit ___ appropriate footwear?

APPENDIX C

Data Acquisition Log

2013 King County River Recreation Study - Data Acquisition Log

Snoqualmie Field Observations

Location		# of Completed Observation Days			Date	22-Jun	30-Jun	7-Jul	14-Jul	19-Jul	21-Jul	24-Jul	4-Aug	6-Aug	7-Aug	11-Aug	18-Aug	21-Aug	22-Aug	25-Aug	31-Aug	1-Sep	10-Sep	11-Sep
Name	RM	Total	Weekend Days	Weekdays	Day of Week	Sat	Sun	Sun	Sun	Fri	Sun	Wed	Sun	Tues	Wed	Sun	Sun	Wed	Thurs	Sun	Sat	Sun	Tues	Wed
		21			High Temp at North Bend	77.3 F	92.9 F	76.0 F	82.3 F	80.8 F	76.7 F	85.1 F	81.7 F	85.9 F	85.9 F	73.3 F	79.8 F	81.3 F	83.5 F	72.5 F	82.3 F	81.6 F	79.1 F	92.5 F
436th Avenue SE Bridge	South Fk LB - RM 5.95	7	4	3					X				X		X				X	X	X		X	
SR 202 (Bendigo Blvd) Bridge	South Fk RB - RM2.9	7	4	3		X			X						X				X	X	X		X	
SE Mt Si Rd (Tanner Put-in)	Middle Fk LB - RM 4.35	7	4	3					X				X	X					X	X	X		X	
SE 114th St (Blue Hole)	Middle Fk LB - RM 2	7	4	3		X			X					X					X	X	X		X	
428th Ave SE (Three Forks Park)	Mainstem RB - RM 42.2	7	4	3				X	X		X	X							X	X			X	
Snoqualmie Trail Bridge (SE Reinig Rd)	Mainstem R/LB - RM 40.6	7	4	3				X			X	X				X			X	X			X	
Plum Creek Boat Ramp	Mainstem RB - RM 37.3	7	4	3		X	X	X		X								X				X		X
Fall City Boat Ramp	Mainstem LB - RM 34.4	7	4	3				X		X			X			X		X				X		X
Fall City (SR202) Bridge	Mainstem LB - RM 34.0-34.1	7	4	3		X	X			X			X			X			X					X
Aldair Levee	Mainstem LB - RM 32.8	7	4	3											X	X	X	X		X	X			X
Neal Road Boat Ramp	Mainstem RB - RM 31	7	4	3						X			X			X	X	X		X				X
Tolt RM 1.8-1.9	Tolt RB - RM 1.8-1.9	7	4	3			X				X	X					X	X				X		X
Tolt RM 0.5	Tolt RB - RM 0.5	7	4	3			X				X	X					X	X				X		X
Tolt-Snoqualmie Confluence	Tolt RB - RM 0	7	4	3		X	X	X		X	X								X					X

Remote Camera Observations

Location	River	Installation Date	Date of Data Download		
Fall City Above Bridge RM 34.7 pting Dstream	Snoq	28-Jun	23-Jul	19-Aug	27-Sep
Fall City Above Bridge RM 34.7 pting Ustream	Snoq	28-Jun	23-Jul	19-Aug	27-Sep
Fall City Below Bridge RM 34.1	Snoq	28-Jun	23-Jul	19-Aug	27-Sep
Fall City Below Bridge RM 33.9	Snoq	28-Jun	23-Jul	19-Aug	27-Sep
Rainbow Bend RM 11.4	Cedar	KC Installed	County download		
Belmondo RM 10.3	Cedar	KC Installed			
Ricardi Reach RM 7.4	Cedar	28-Jun	23-Jul	19-Aug	19-Sep
Ricardi Reach RM 7.3	Cedar	28-Jun	23-Jul	19-Aug	19-Sep
Elliott Reach RM 5.6	Cedar	28-Jun	23-Jul	19-Aug	19-Sep
Ron Regis Park RM 4.9	Cedar	28-Jun	23-Jul	19-Aug	19-Sep
Fenster Property RM 32.0	Green	26-Jun	25-Jul	20-Aug	17-Sep
Fenster Property RM 31.9	Green	26-Jun	25-Jul	20-Aug	17-Sep
Isaac Evans Park RM 29.3	Green	26-Jun	25-Jul	20-Aug	17-Sep
Isaac Evans Park RM 29.1	Green	26-Jun	25-Jul	20-Aug	17-Sep
Russel Woods Park RM 19.4	Green	26-Jun	25-Jul	20-Aug	17-Sep
Van Dorens Park RM 18.5	Green	26-Jun	25-Jul	20-Aug	17-Sep
Briscoe Park RM 16.5	Green	26-Jun	25-Jul	20-Aug	17-Sep
Briscoe Park RM 15.9	Green	26-Jun	25-Jul	20-Aug	17-Sep
Pacific City Park RM 6.1	White	26-Jun	23-Jul	19-Aug	17-Sep
Pacific City Park RM 5.9	White	26-Jun	23-Jul	19-Aug	17-Sep

User Interviews

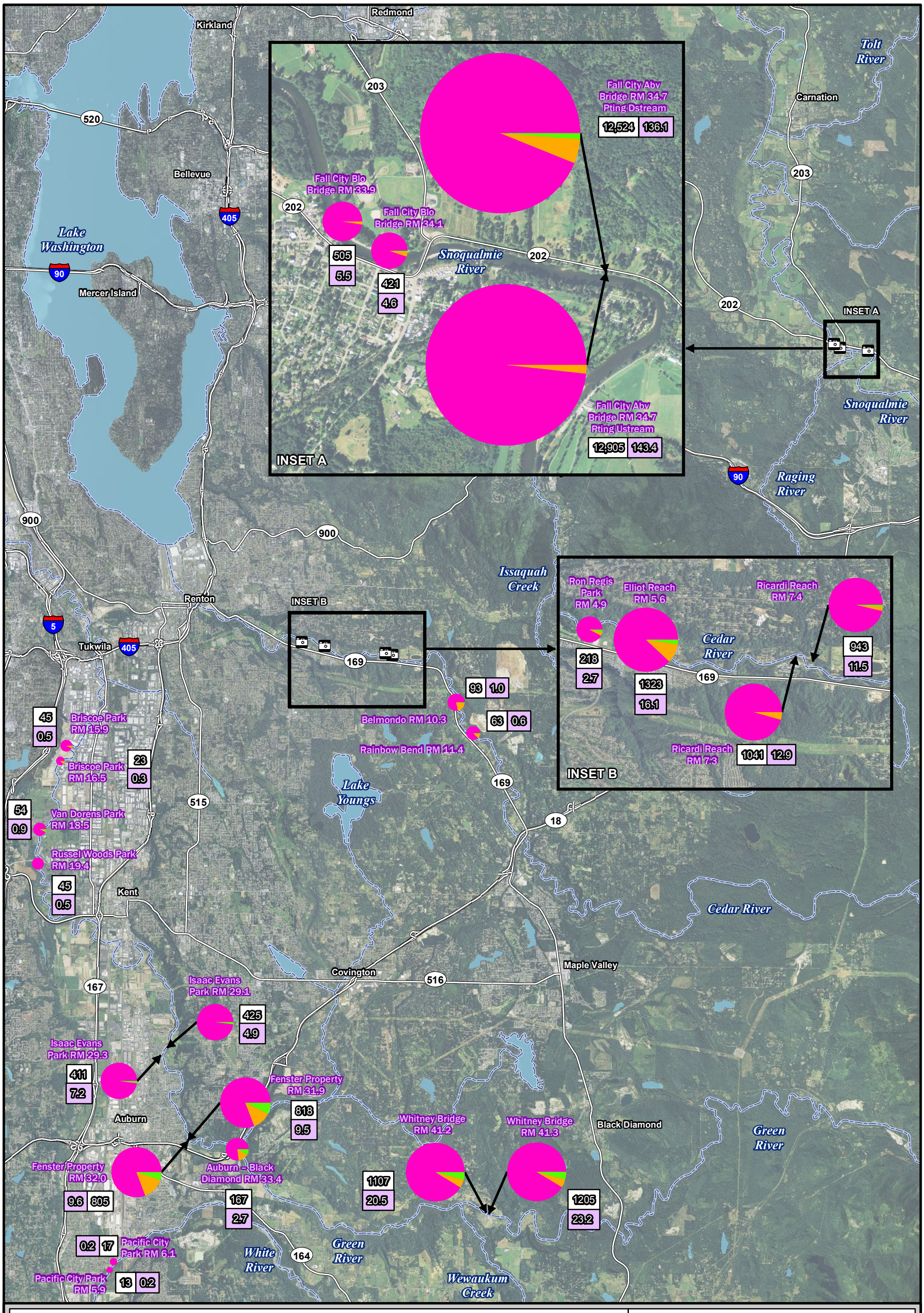
Location	River	Date		
Edgewick	Sno - South Fork		31-Aug	
424th Avenue SE	Sno - South Fork		31-Aug	
SE Mt Si Rd (Tanner Put-in)	Sno - Middle Fork		31-Aug	
SE 114th St (Blue Hole)	Sno - Middle Fork		31-Aug	
Plum Creek Boat Ramp	Sno - Main Stem	11-Aug		1-Sep
Fall City Boat Ramp	Sno - Main Stem	11-Aug		1-Sep
Fall City (SR 202) Bridge	Sno - Main Stem	11-Aug		1-Sep
Neal Road Boat Ramp	Sno - Main Stem	11-Aug		
Pacific City Park	White			1-Sep

Aerial Flights

Flight	Flight Date	High Temp at North Bend	Route
#1	7-Jul	76.0 F	White (but no video because of clouds / nav difficulties) - South Fk - Middle Fk - Mainstem Sno - Tolt - Cedar - Green
#1	18-Aug	79.8 F	White River
#2	24-Aug	73.3 F	two helicopters - still photos - all rivers

APPENDIX D

GIS Summary Maps and Tables



Legend

Total People by Age Group

17

Adults

Youth (12 to 17)

Children (1 to 11)

Remote camera location (see insets for more detail)

17 Average people per day

City or town

Highway

River

Figure D-1. Total People Observed and Age Categories by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

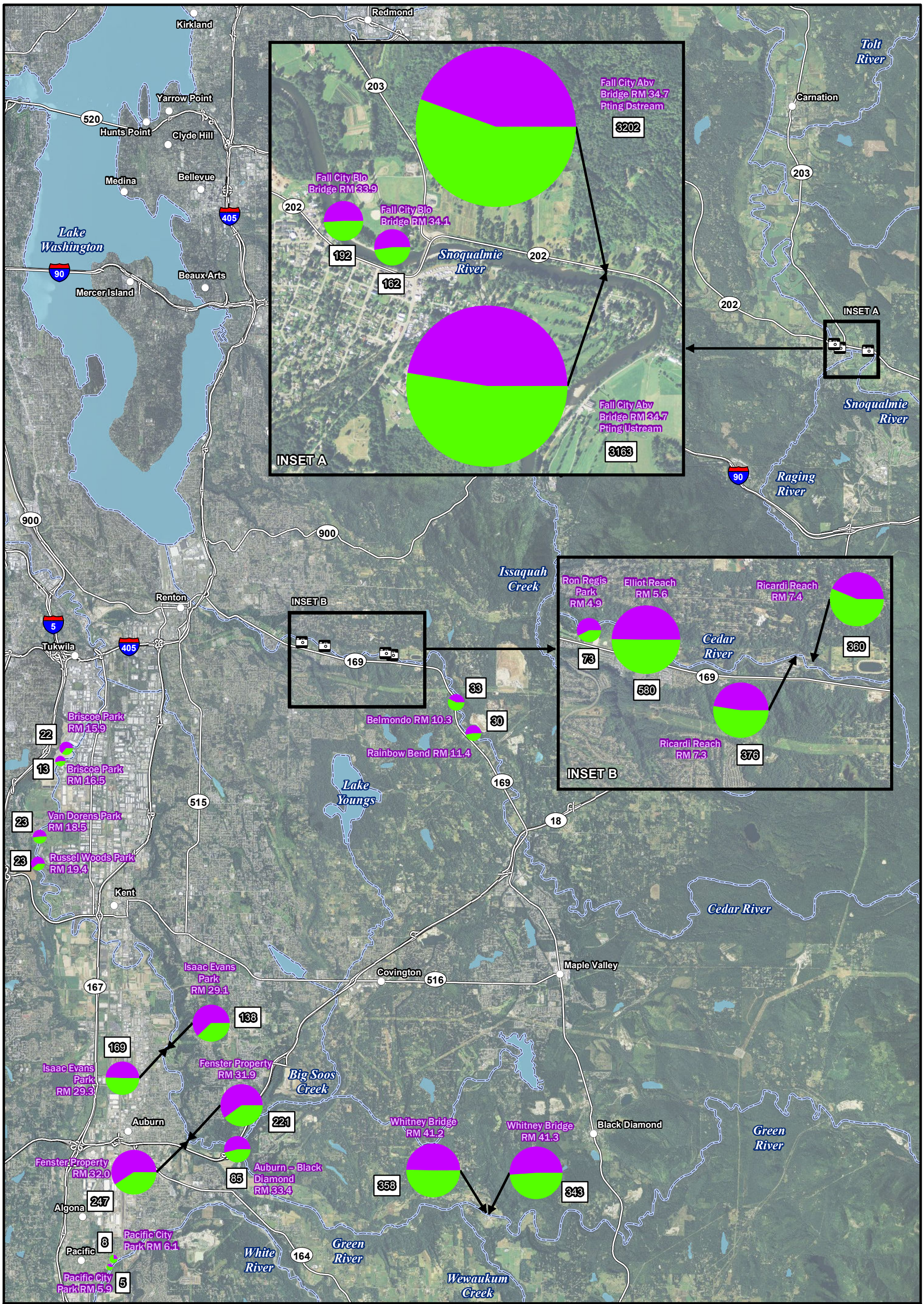
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_age.mxd (10/6/2014)



Legend

Total Groups Observed on Weekends and Weekdays

17

Weekdays

Weekends

Remote camera location (see insets for more detail)

City or town

Highway

River

Figure D-2. Observations on Weekends and Weekdays by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

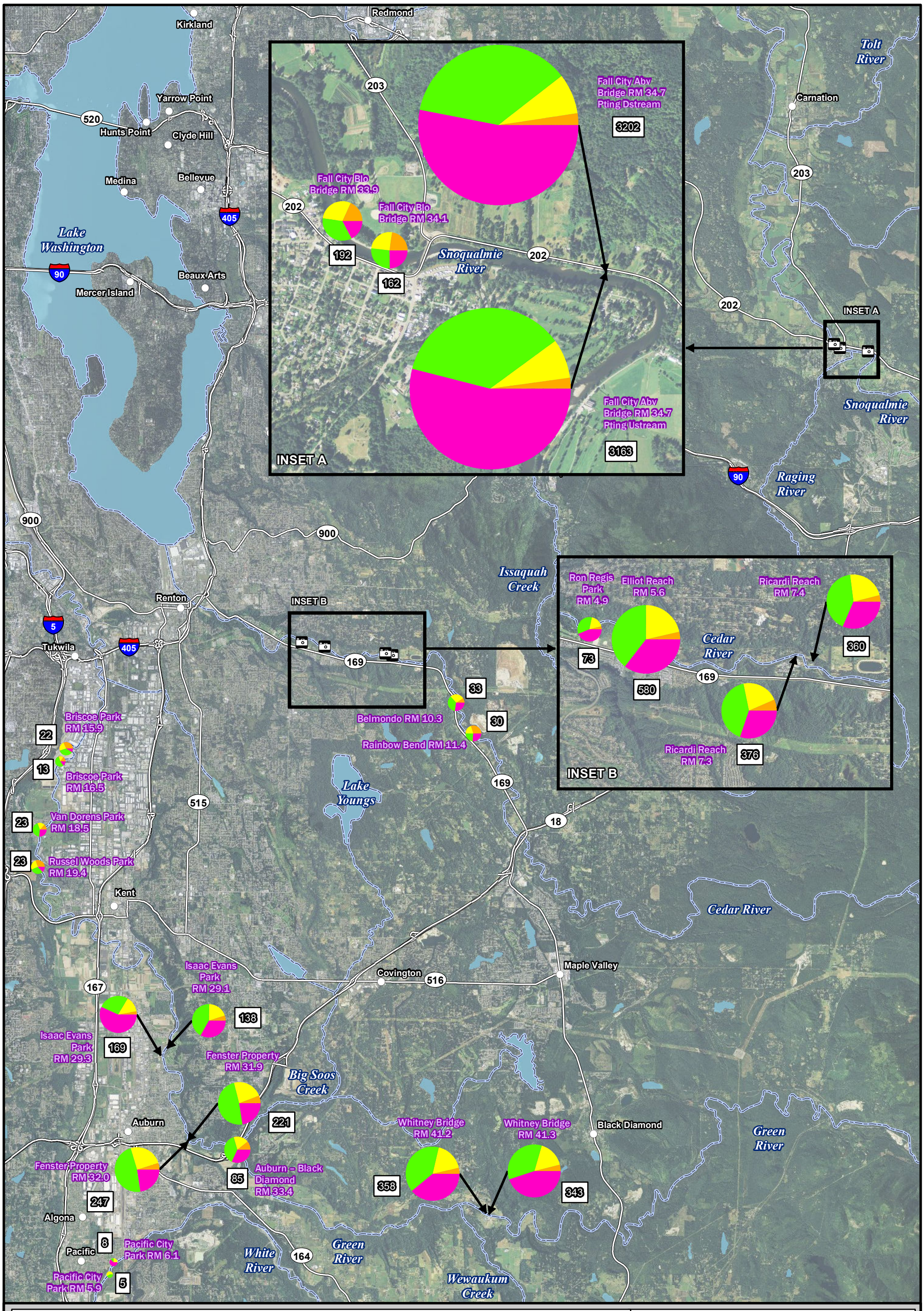
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_days_of_week.mxd (10/7/2014)



Legend

Total Groups Observed on Time of Day

17

- 11AM to 1PM
- 1PM to 3PM
- 3PM to 5PM
- 5PM to 7PM

Remote camera location (see insets for more detail)

City or town

Highway

River

Figure D-3. Observations by Time of Day and Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

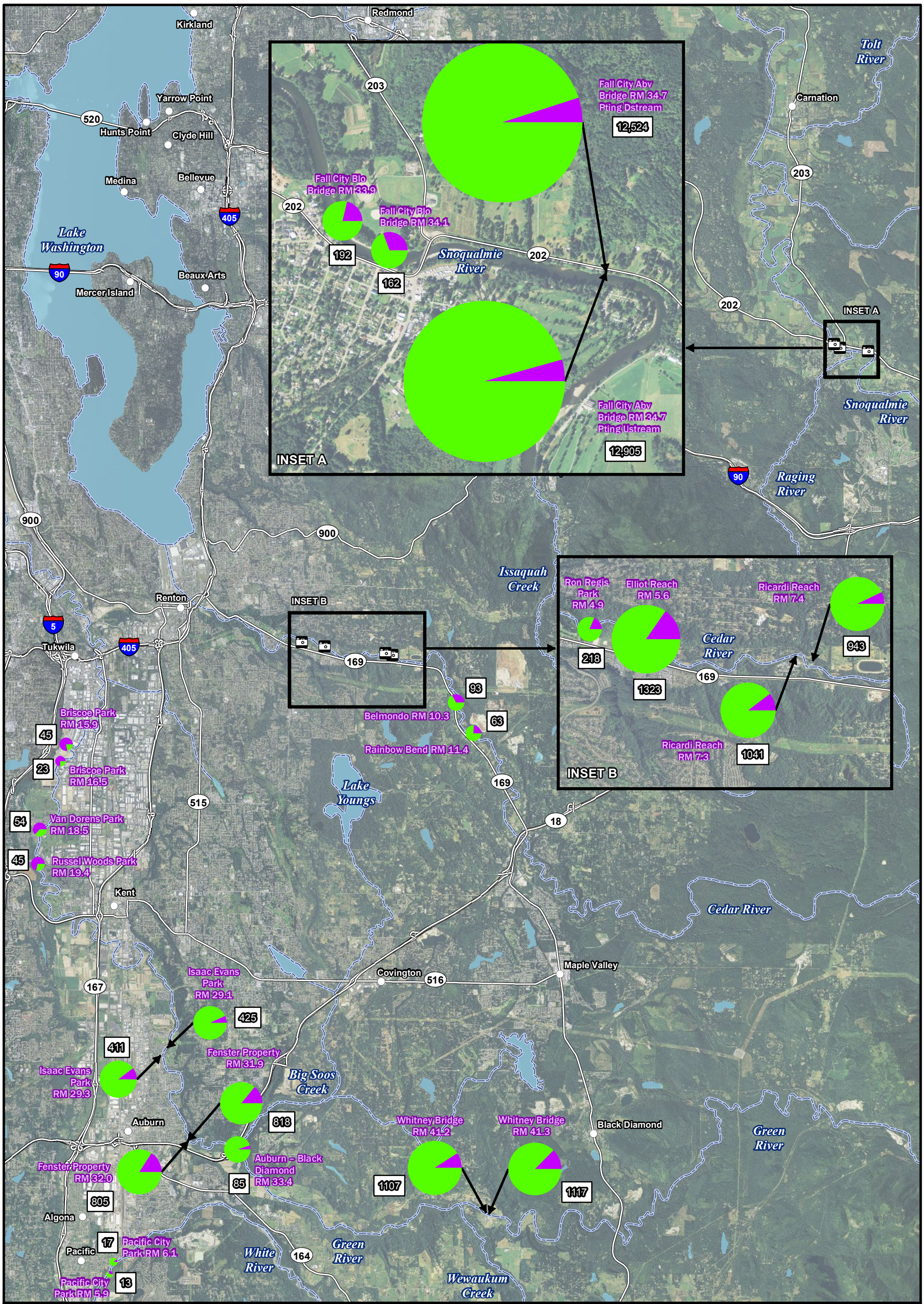
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_time_of_day.mxd (10/7/2014)



Legend

Total People With and Without Life Vests

17

Without vests

With vests

Remote camera location (see insets for more detail)

City or town

Highway

River

Figure D-4. People Observed Wearing Life Vests by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

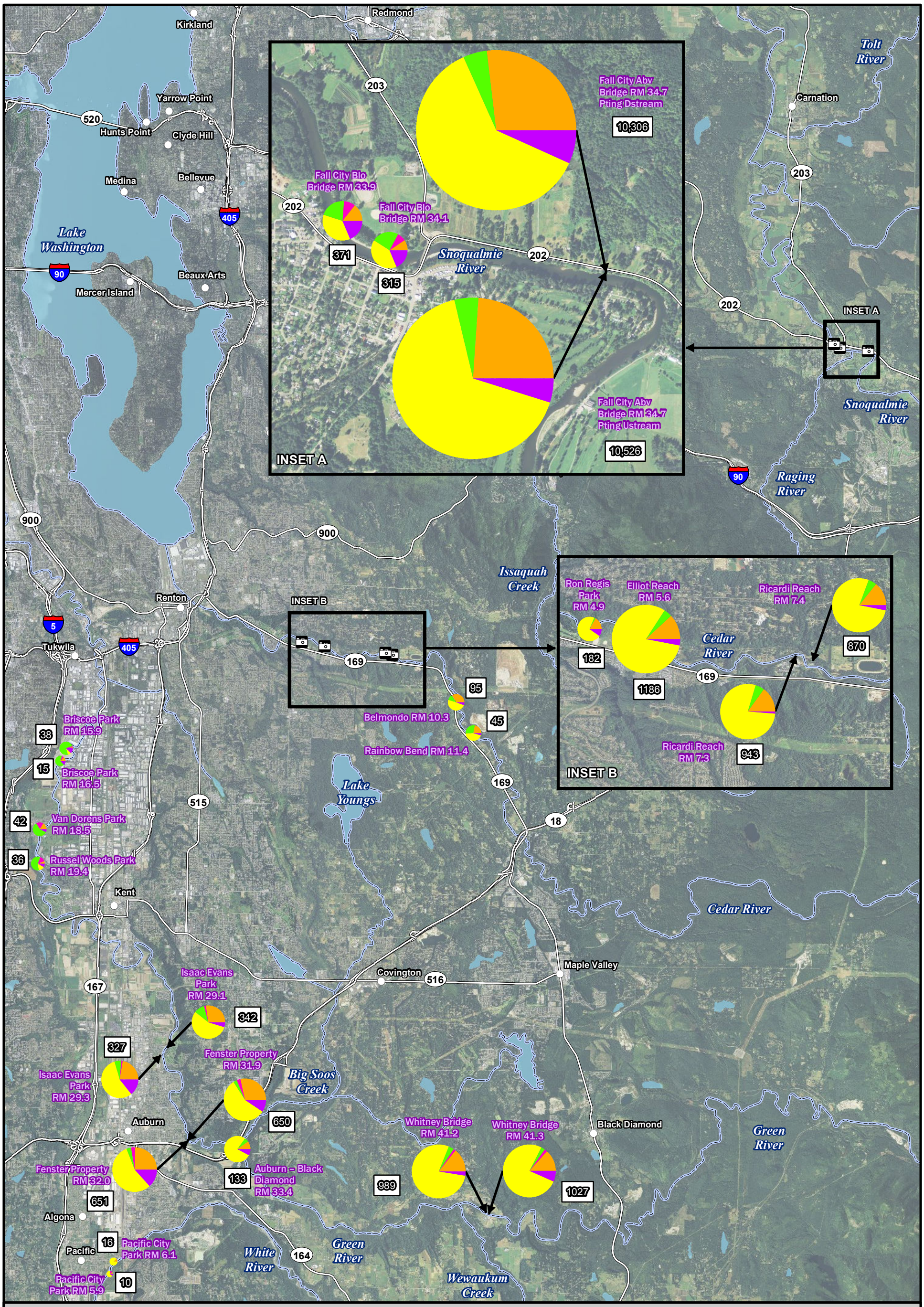
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_life_vest.mxd (10/7/2014)



Legend

Total Vessels by Category

17

Rafts

Other

Canoes

Kayaks

Tubes

Remote camera location (see insets for more detail)

City or town

Highway

River

Figure D-5. Vessel Categories Observed by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

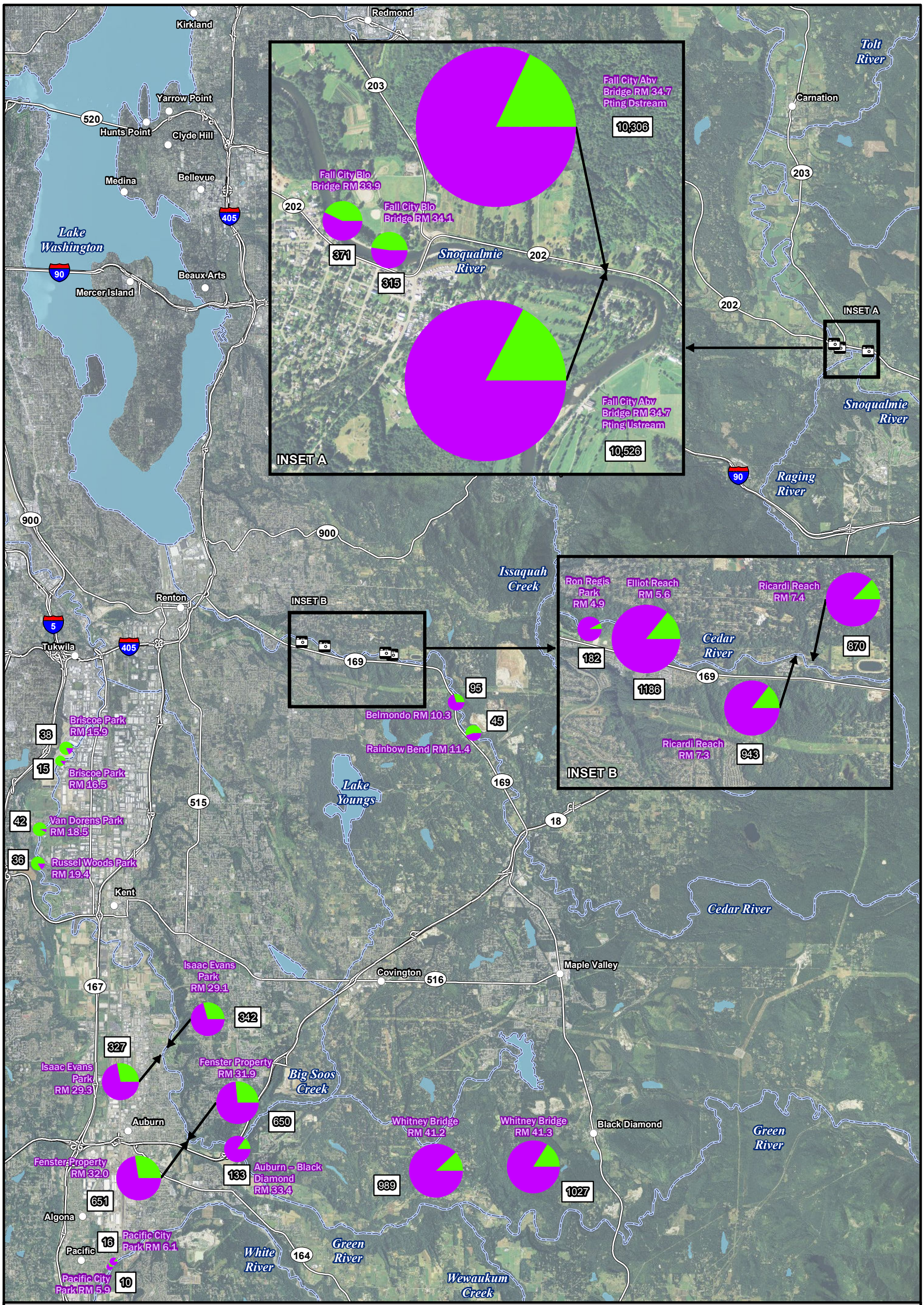
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_vessel_summarys.mxd (10/7/2014)



Legend

Total Vessels with and without Paddles

17

With Paddles

Without Paddles

Remote camera location (see insets for more detail)

City or town

Highway

River

Figure D-6. Vessels Observed with Paddles by Remote Camera Location for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

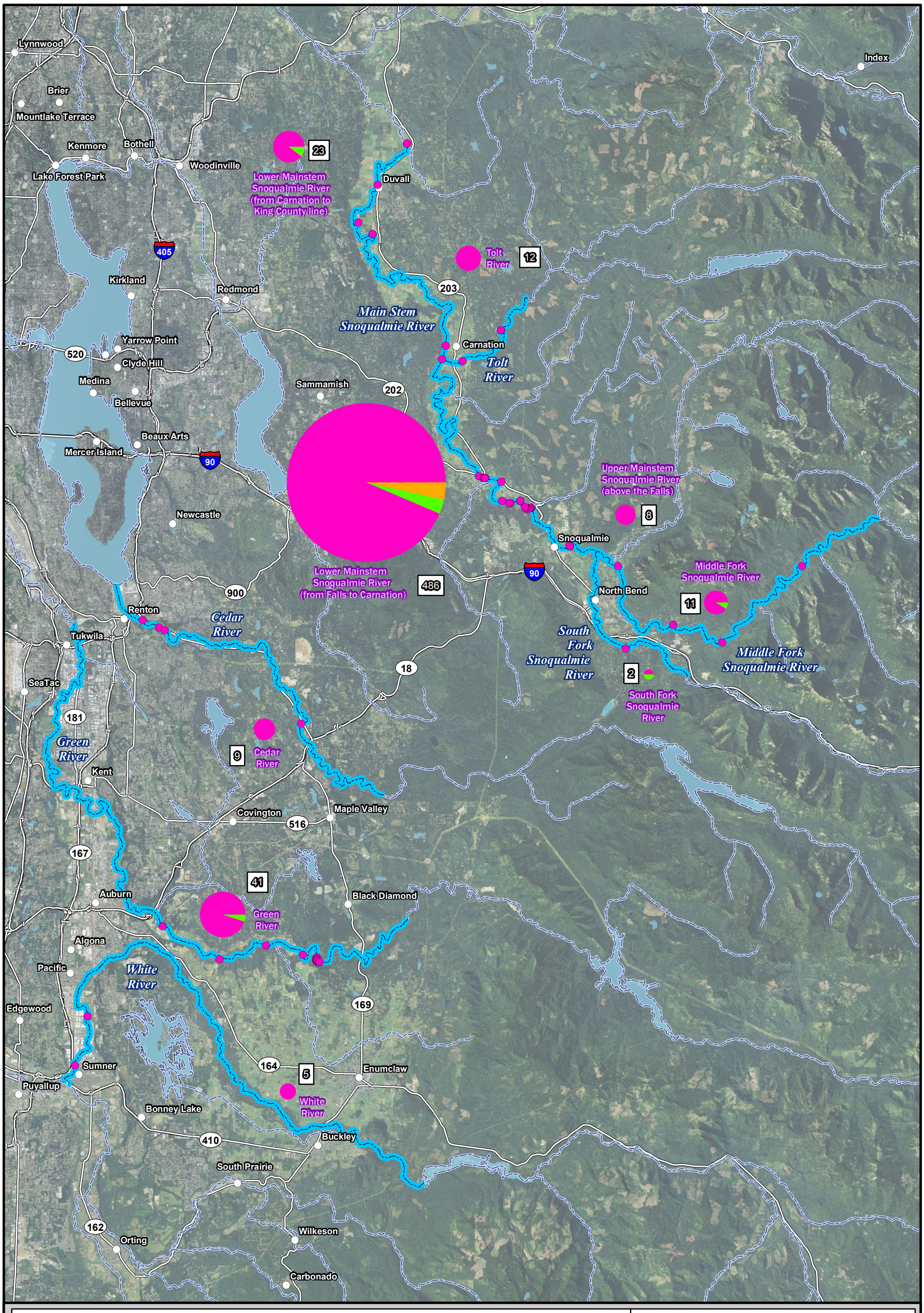
0 5,500 11,000 22,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Remote_Cameras\remote_camera_vessels_with_paddles.mxd (10/7/2014)



Legend

Total People by Age Group: 17

- Aerial survey observation location
- Aerial survey reach
- City or town
- Highway
- River
- Adults (18+)
- Youth (12 to 11)
- Children (1 to 11)

Figure D-7. Total People Observed and Age Categories by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

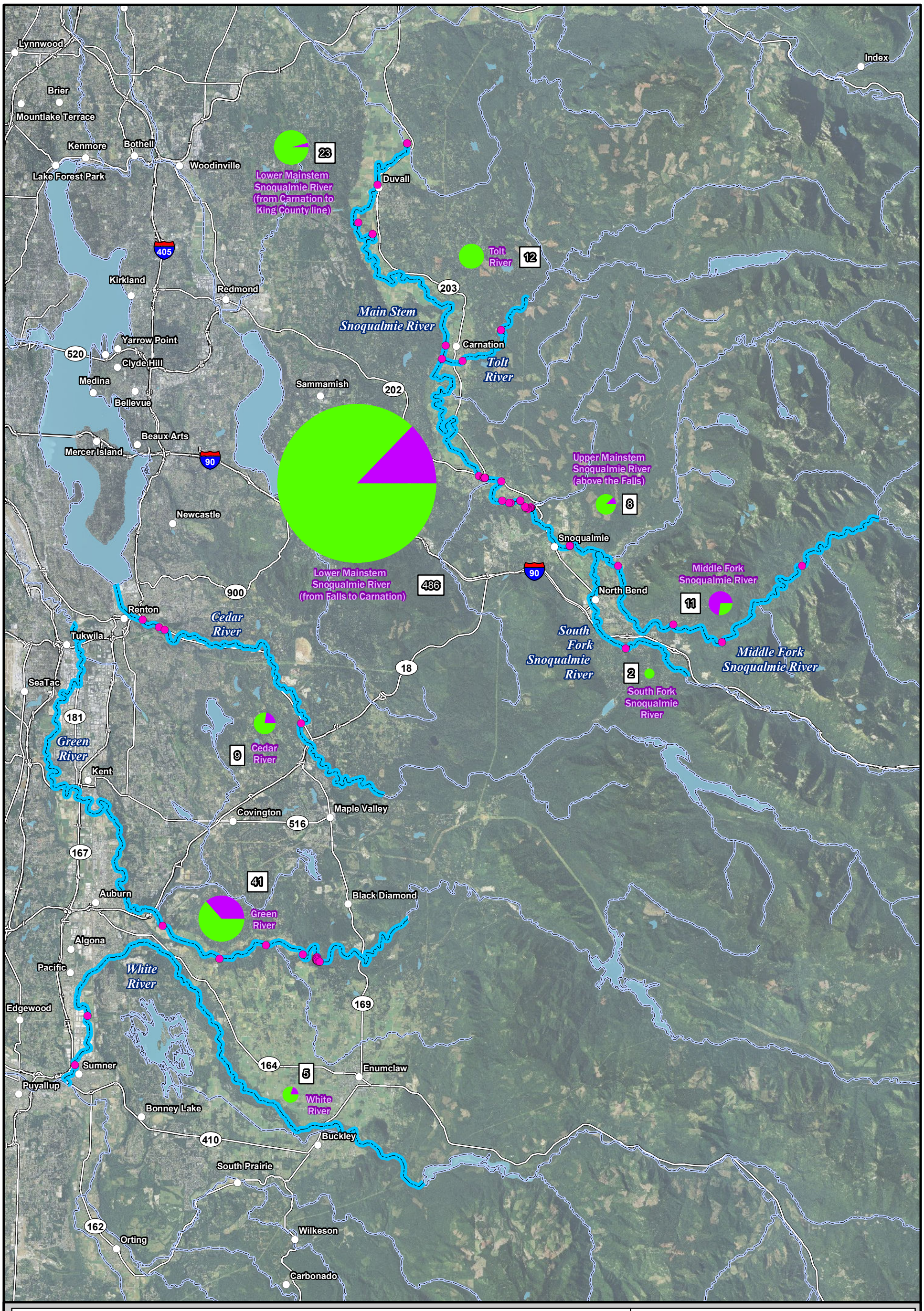
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Age_Groups.mxd (10/7/2014)



Legend

Total People With and Without Life Vests

17

With vests

Without vests

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-8. People Observed Wearing Life Vests by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

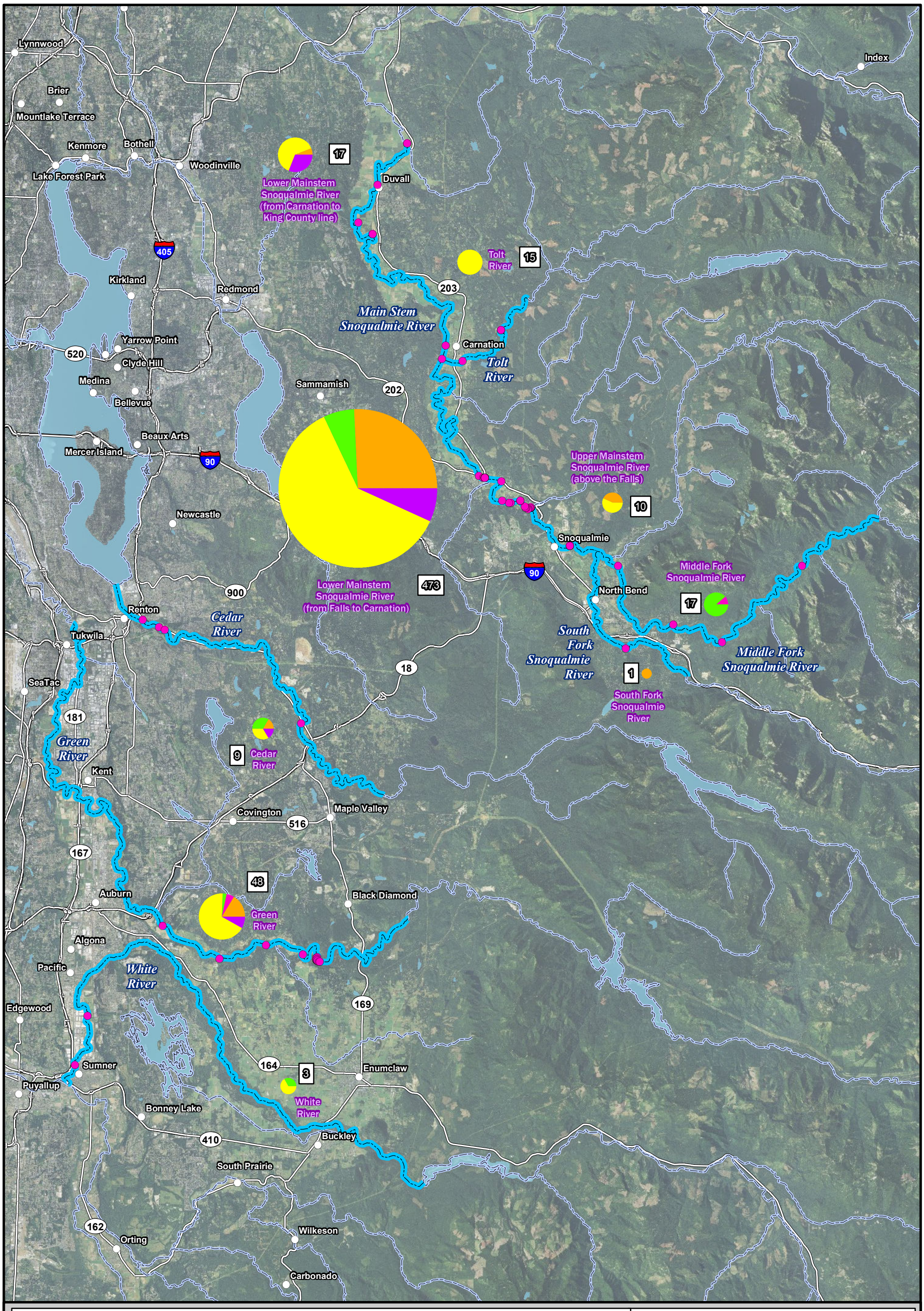
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Life_Vests.mxd (10/7/2014)



Legend

Total Vessels by Category

17

Rafts

Tubes

Canoes

Other

Kayaks

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-9. Vessels Observed by Category by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

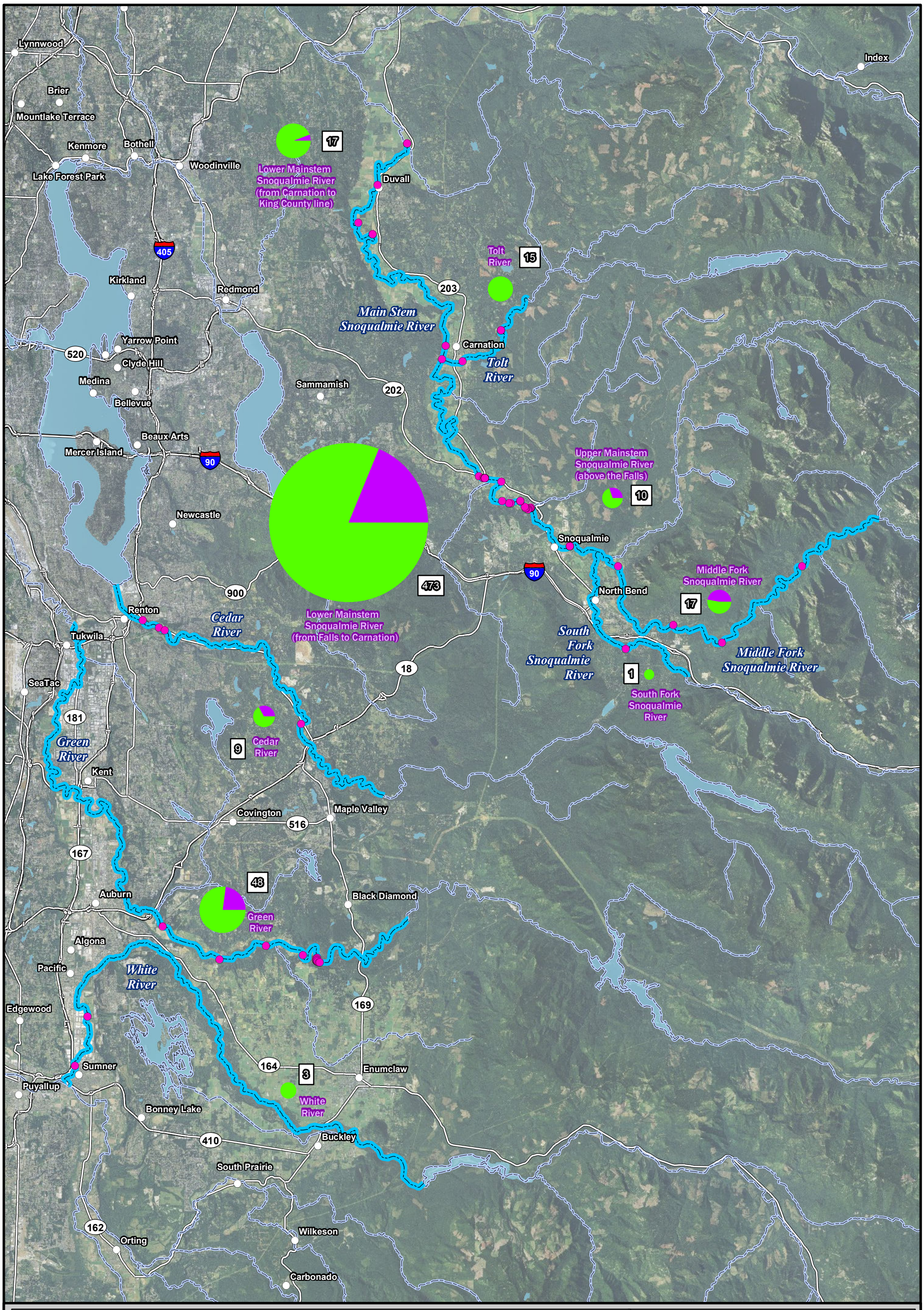
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Vessel_Categories.mxd (10/7/2014)



Legend

Total Vessels with and without Paddles

17

With paddles

Without paddles

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-10. Vessels Observed with Paddles by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

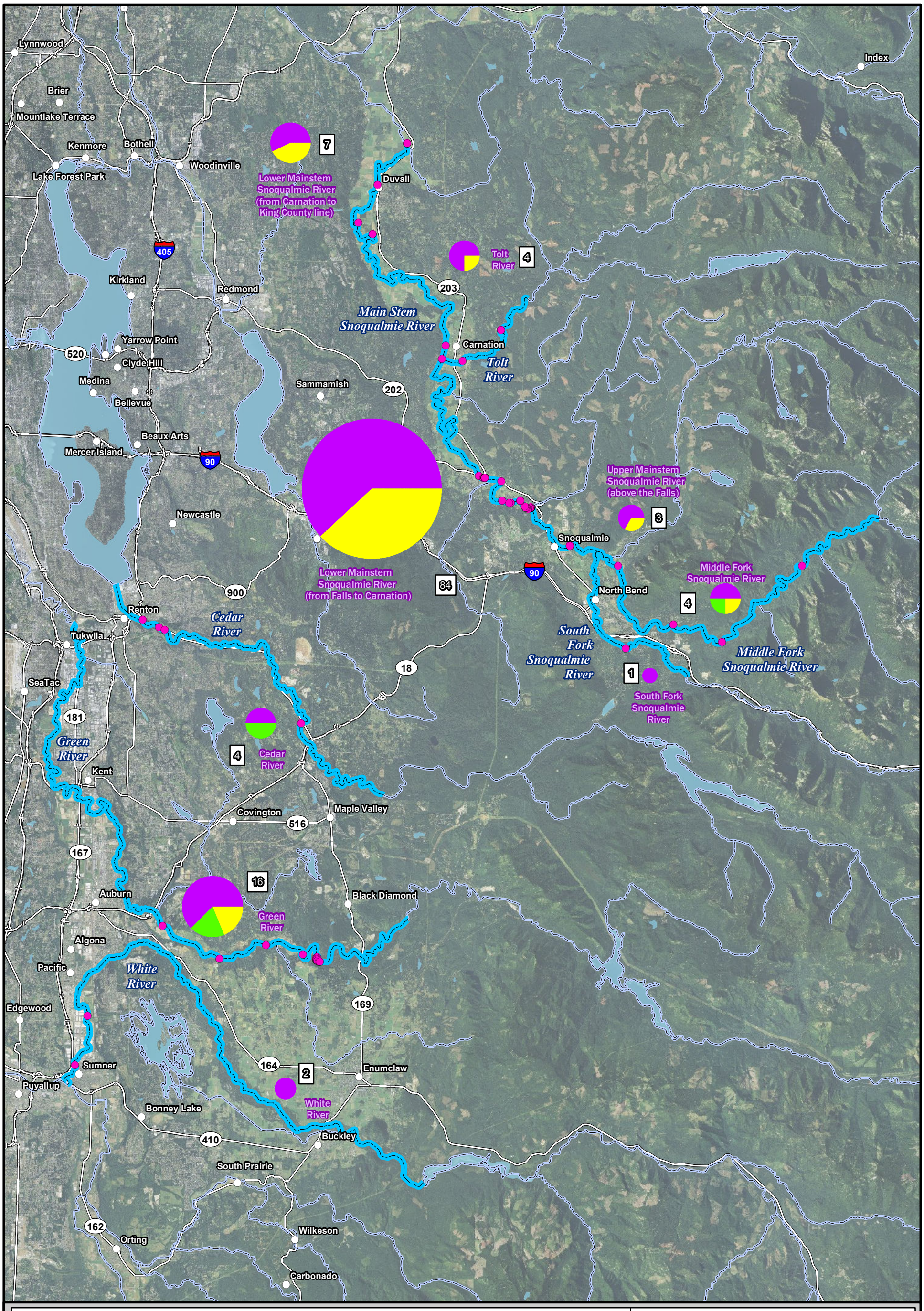
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Paddles.mxd (10/7/2014)



Legend

Did the group have coolers visible?

17

No

Unknown

Yes

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-11. Percentage of Total Groups Observed with Coolers by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

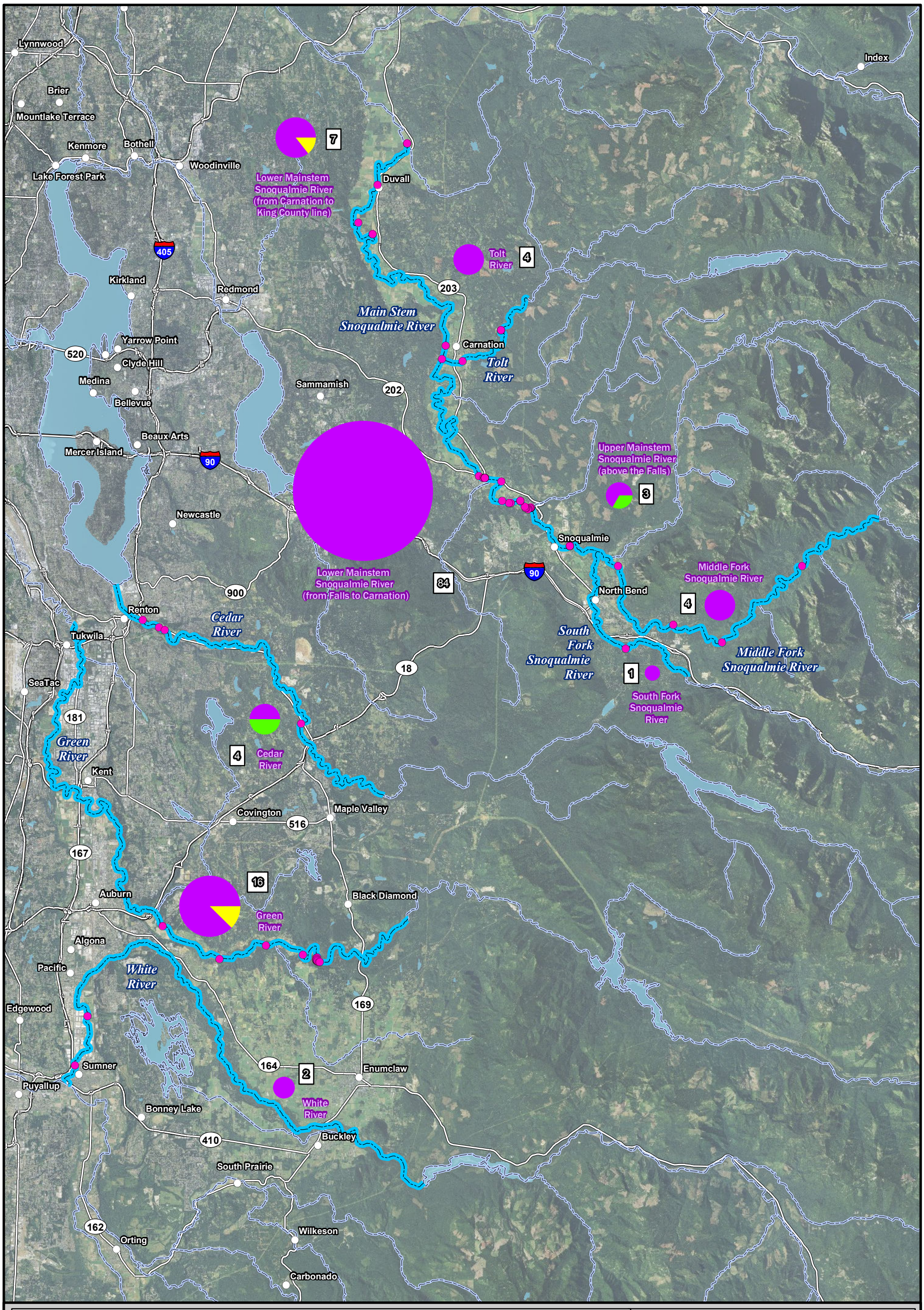
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Coolersmxd.mxd (10/7/2014)



Legend

Did the group have fishing equipment visible?

17

No

Unknown

Yes

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-12. Percentage of Total Groups Observed with Fishing Equipment by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

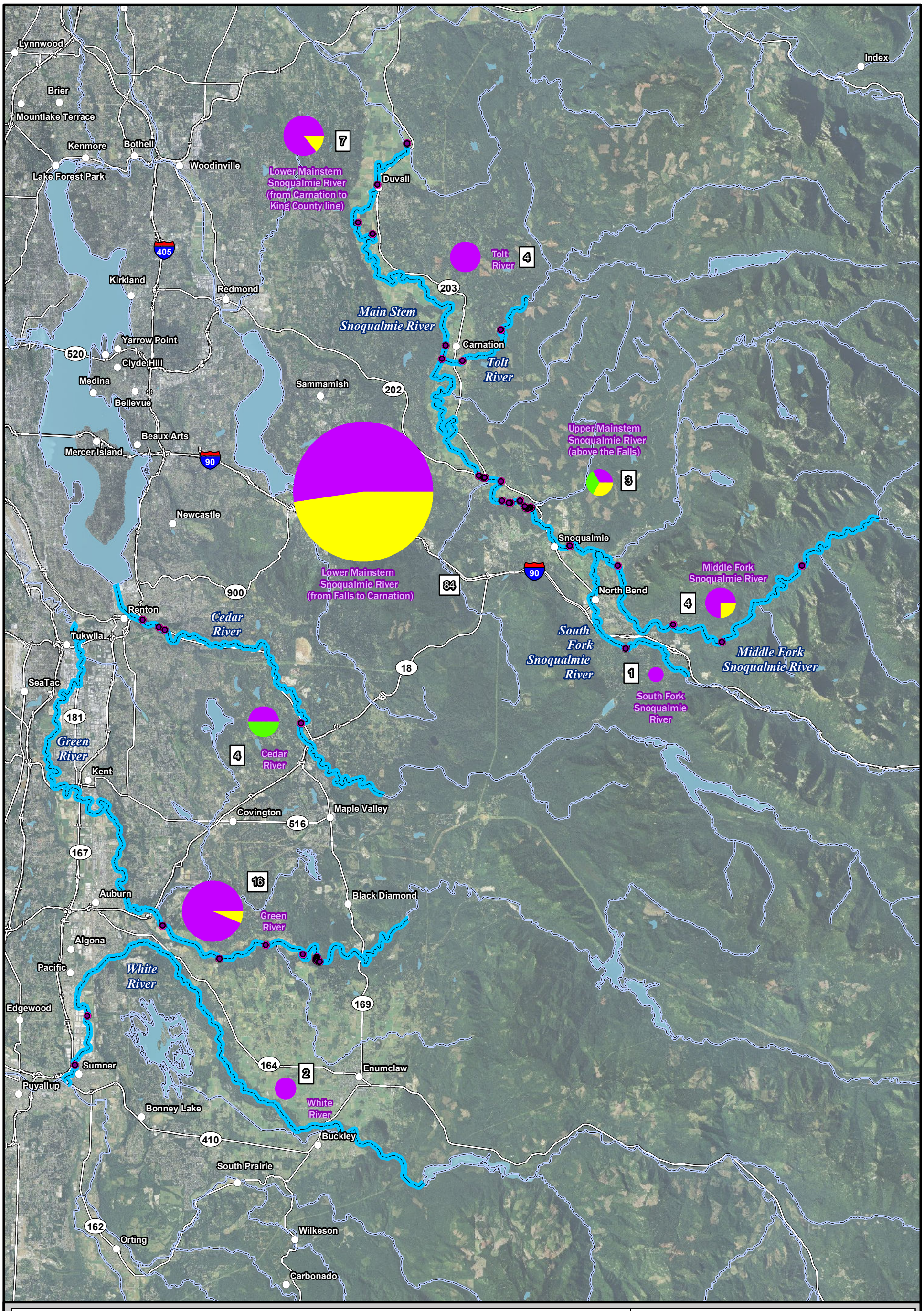
0 2 4 8 Miles

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Fishing.mxd (10/7/2014)



Legend

Did the group have alcohol visible?

17

No

Unknown

Yes

Aerial survey observation location

Aerial survey reach

City or town

Highway

River

Figure D-13. Percentage of Total Groups Observed with Alcohol by Aerial Survey Reach for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 2 4 8 Miles

King County

Aerial: USDA (2013)
Prepared for King County by Herrera
K:\Projects\Y2010\10-04766-040\Project\Aerial_Surveys\Helicopter_Alcohol.mxd (10/7/2014)

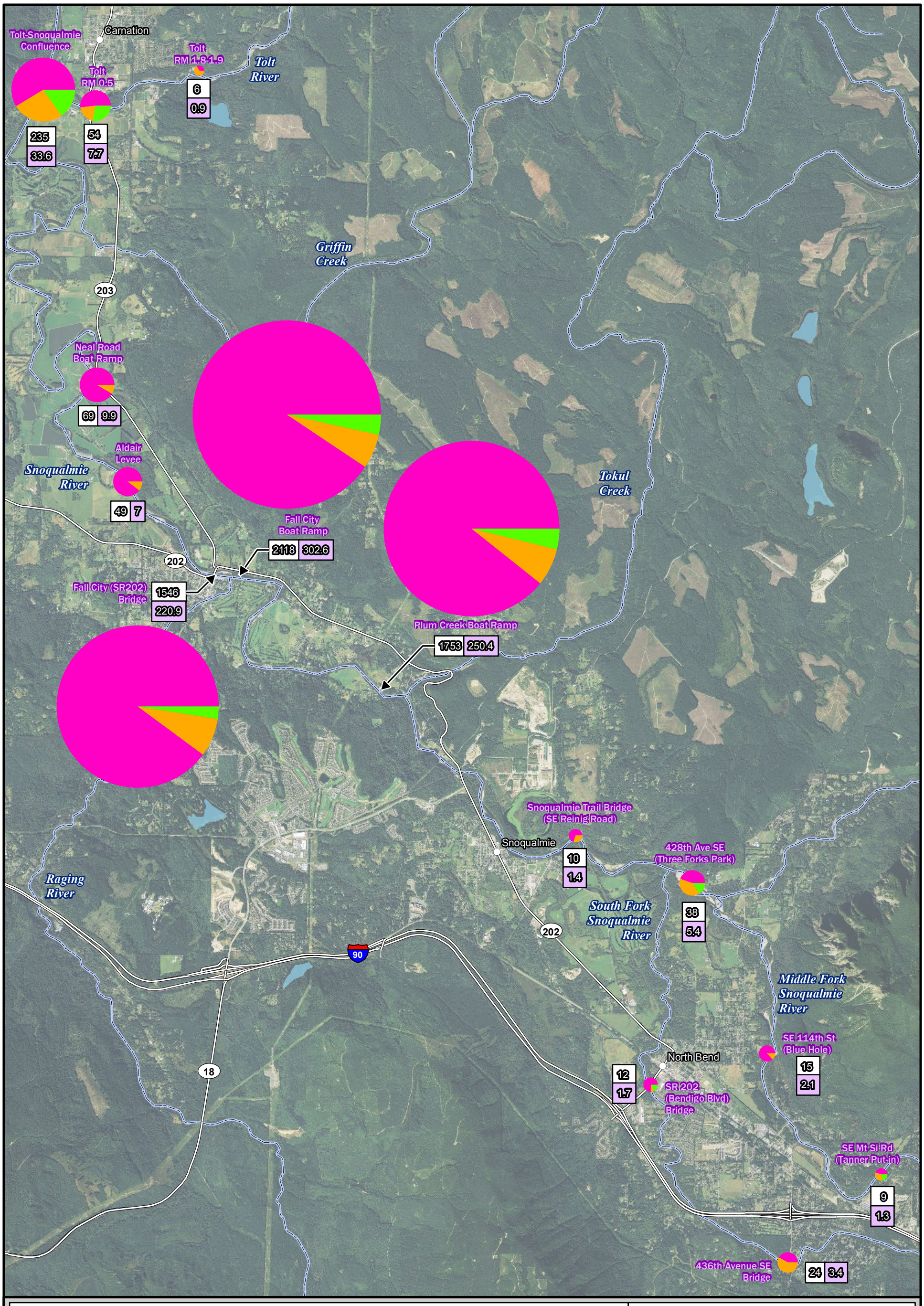
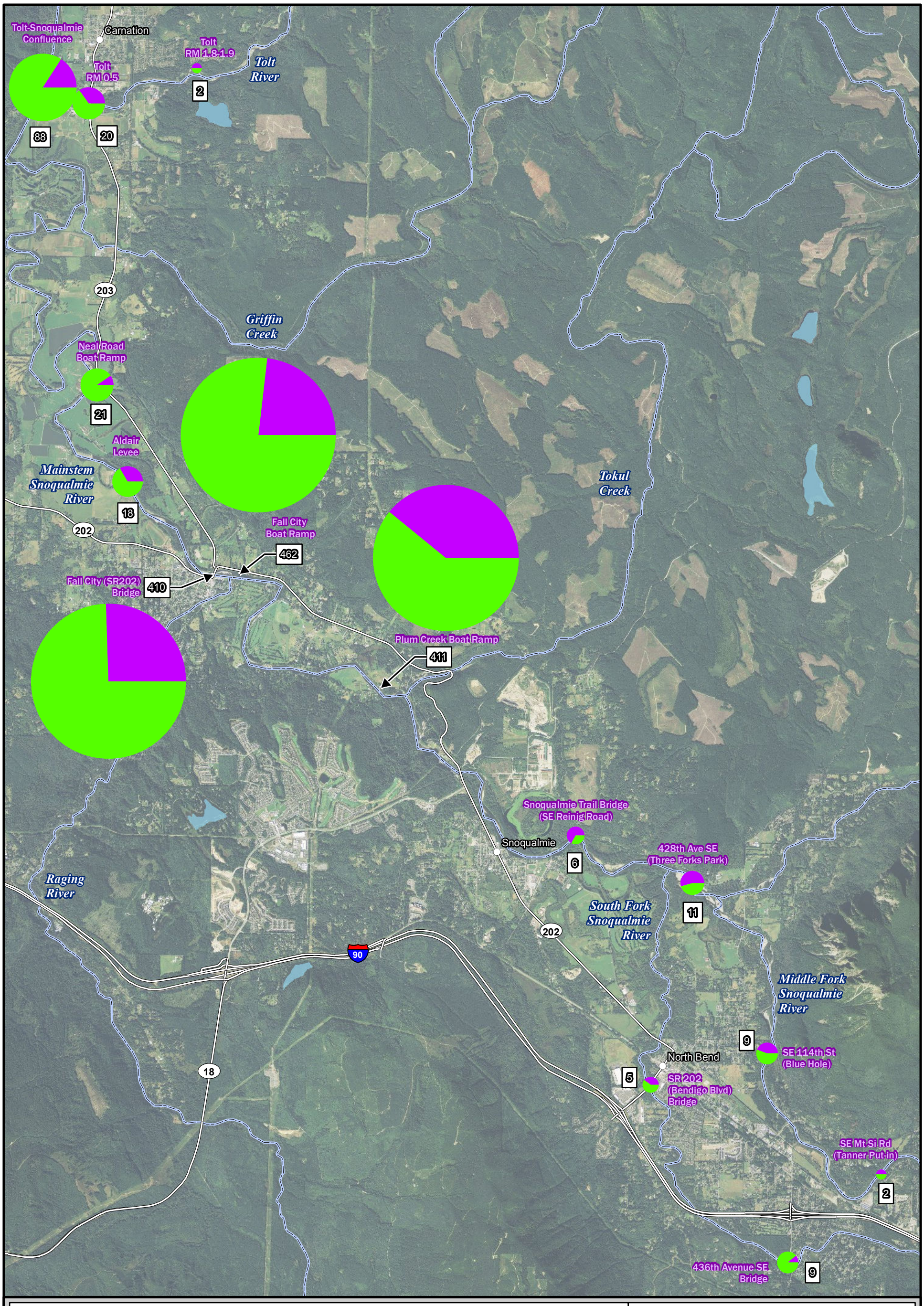


Figure D-14. Total People Observed and Age Categories by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.



Legend

Total Groups Observed on Weekends and Weekdays

125

Weekday

Weekend

City or town

Highway

River

Figure D-15. Observations on Weekends and Weekdays by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

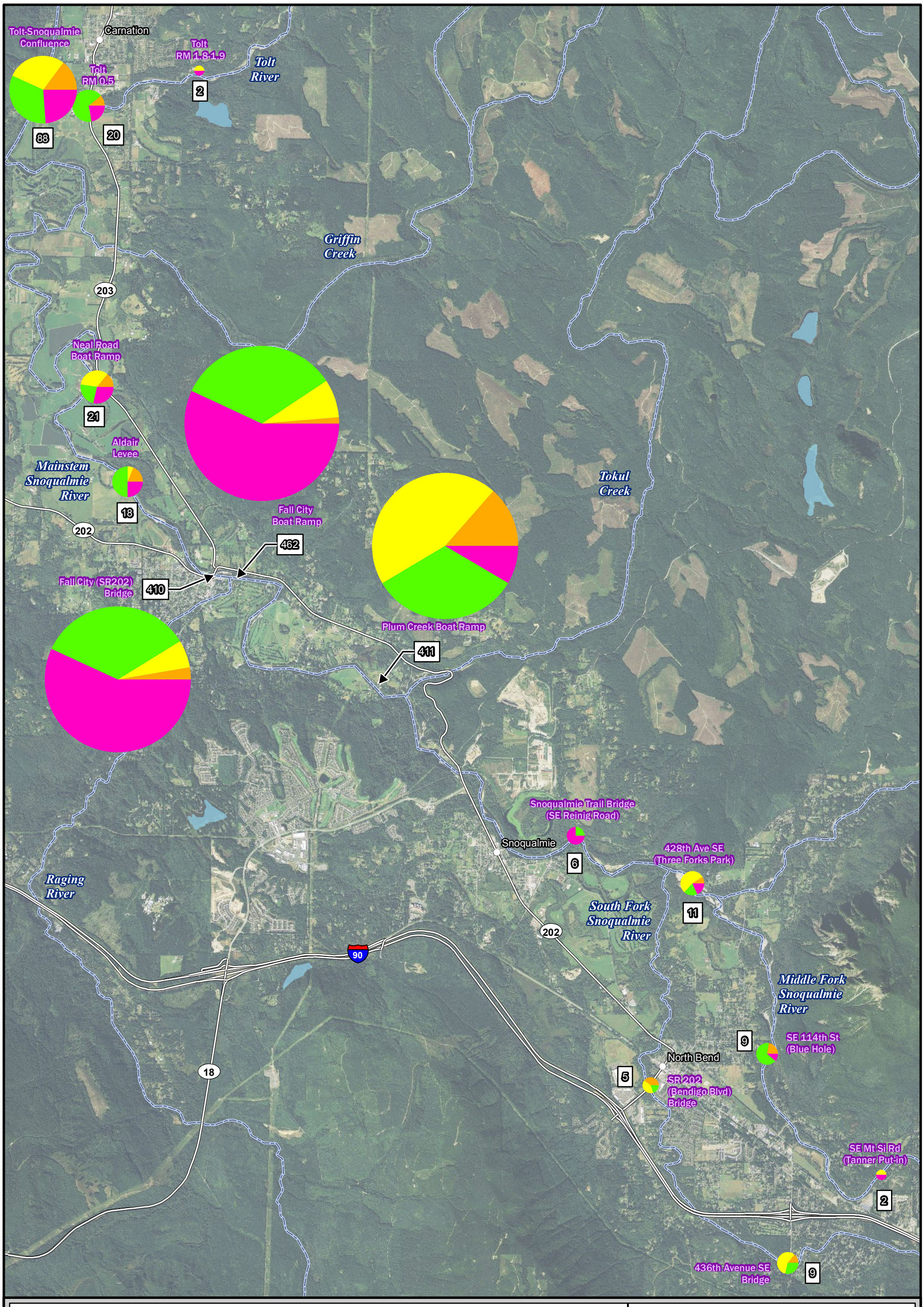
N

0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)

Prepared for King County by Herrera



Legend

Total Groups Observed on Time of Day

17

- 11AM to 1PM
- 1PM to 3PM
- 3PM to 5PM
- 5PM to 7PM

- City or town
- Highway
- River

Figure D-16. Observations by Time of Day and Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

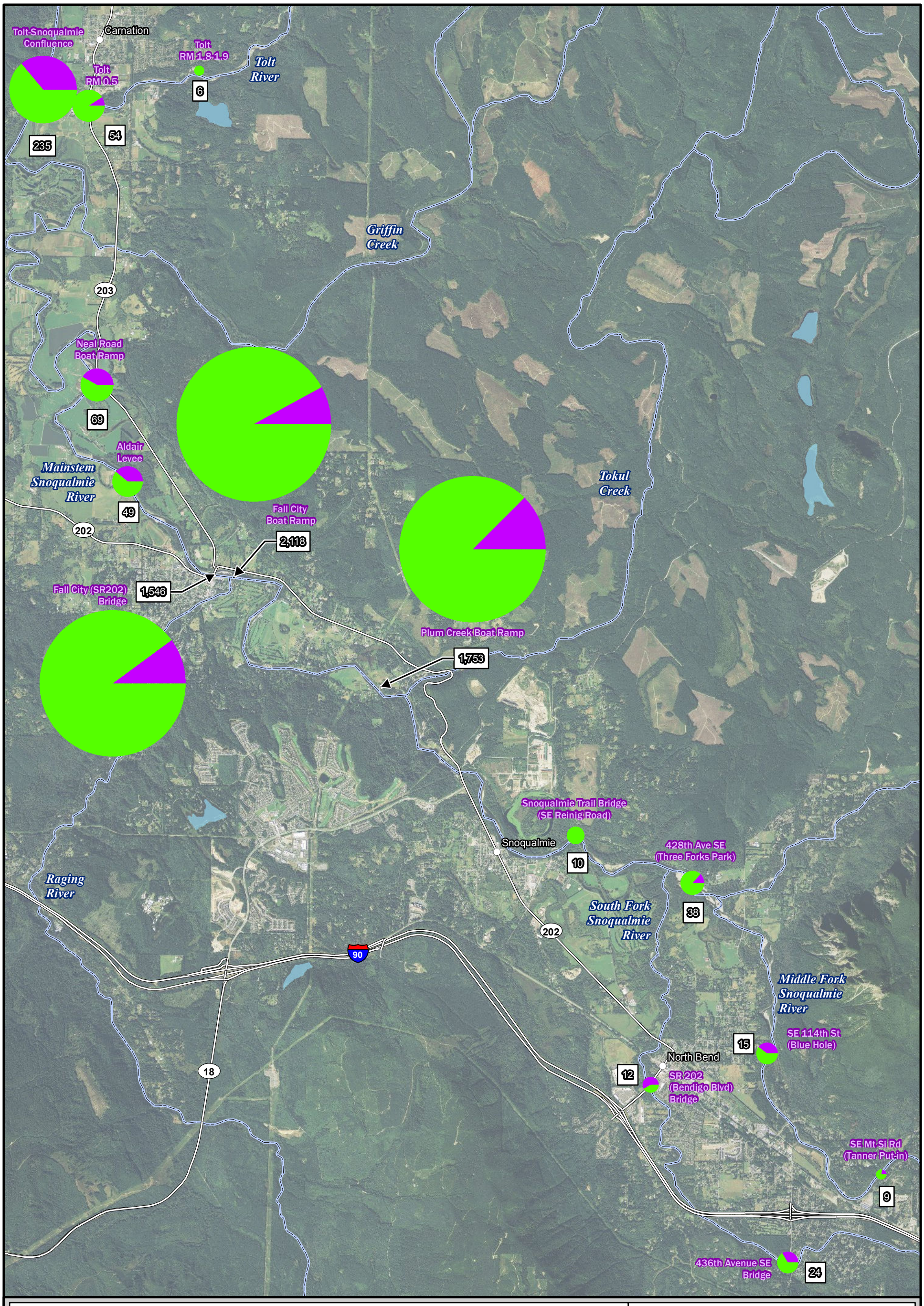
0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\time_of_day.mxd (10/7/2014)



Legend

Total People With and Without Life Vests

125

Without vests

With vests

City or town

Highway

River

Figure D-17. People Observed Wearing Life Vests by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

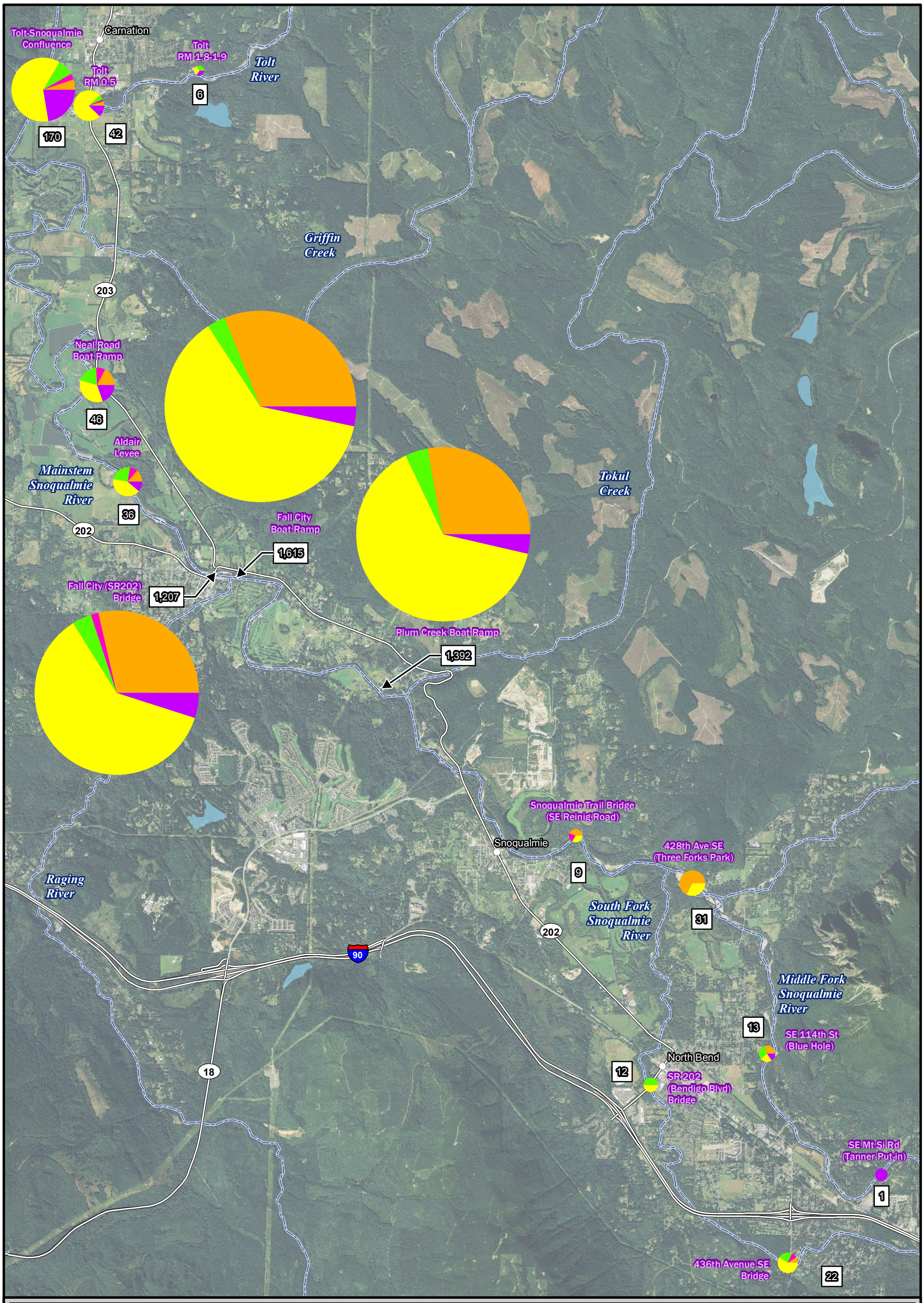
0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2013)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\life_vests.mxd (10/7/2014)



Legend

Total Vessels by Category

125

Rafts
Canoes
Kayaks
Tubes
Other

City or town
Highway
River

Figure D-18. Vessel Categories Observed by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)
Prepared for King County by Herrera
K:\Projects\Y2010\10-04766-040\Project\Field_Observation\vessel_summarys.mxd (10/7/2014)

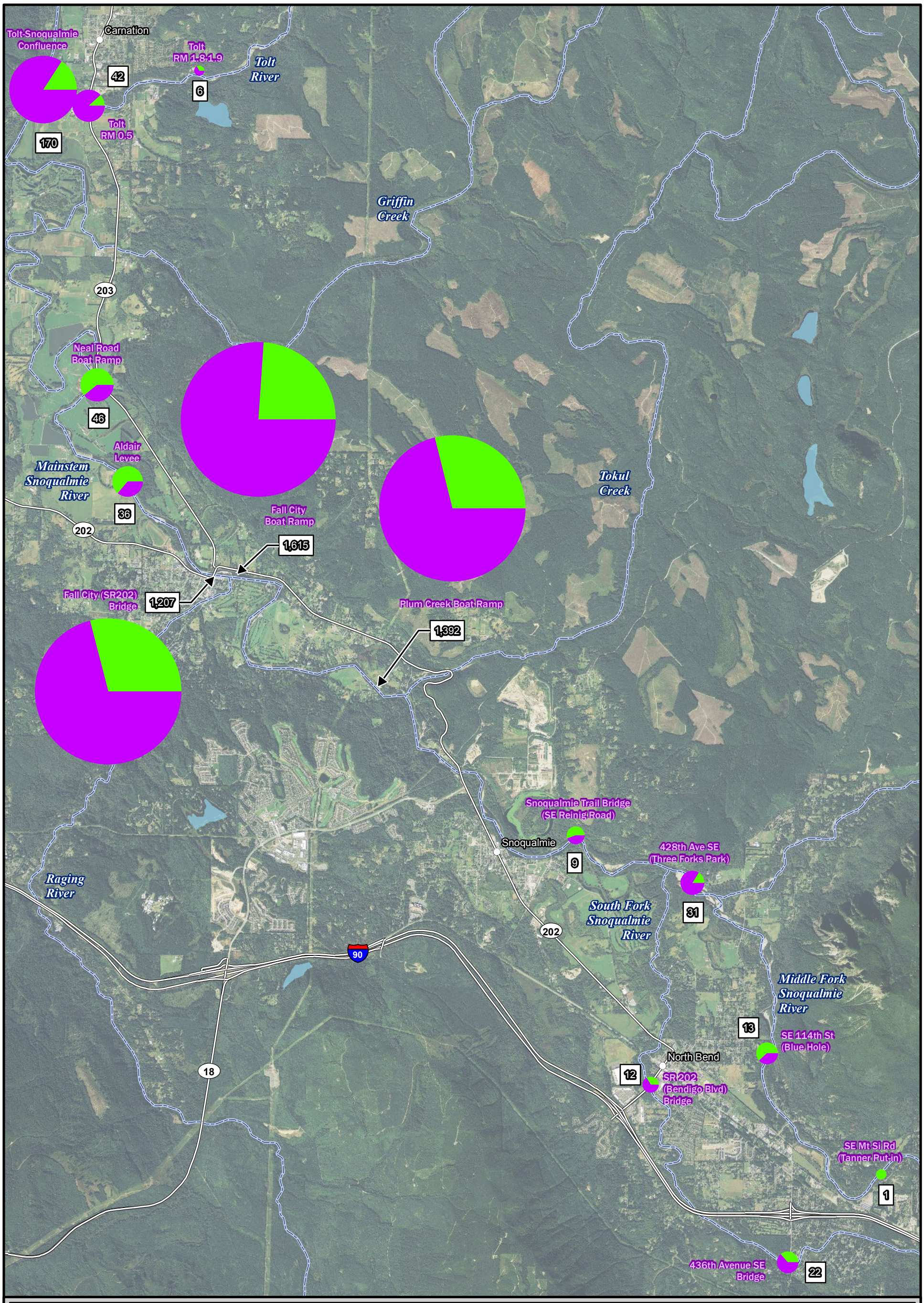
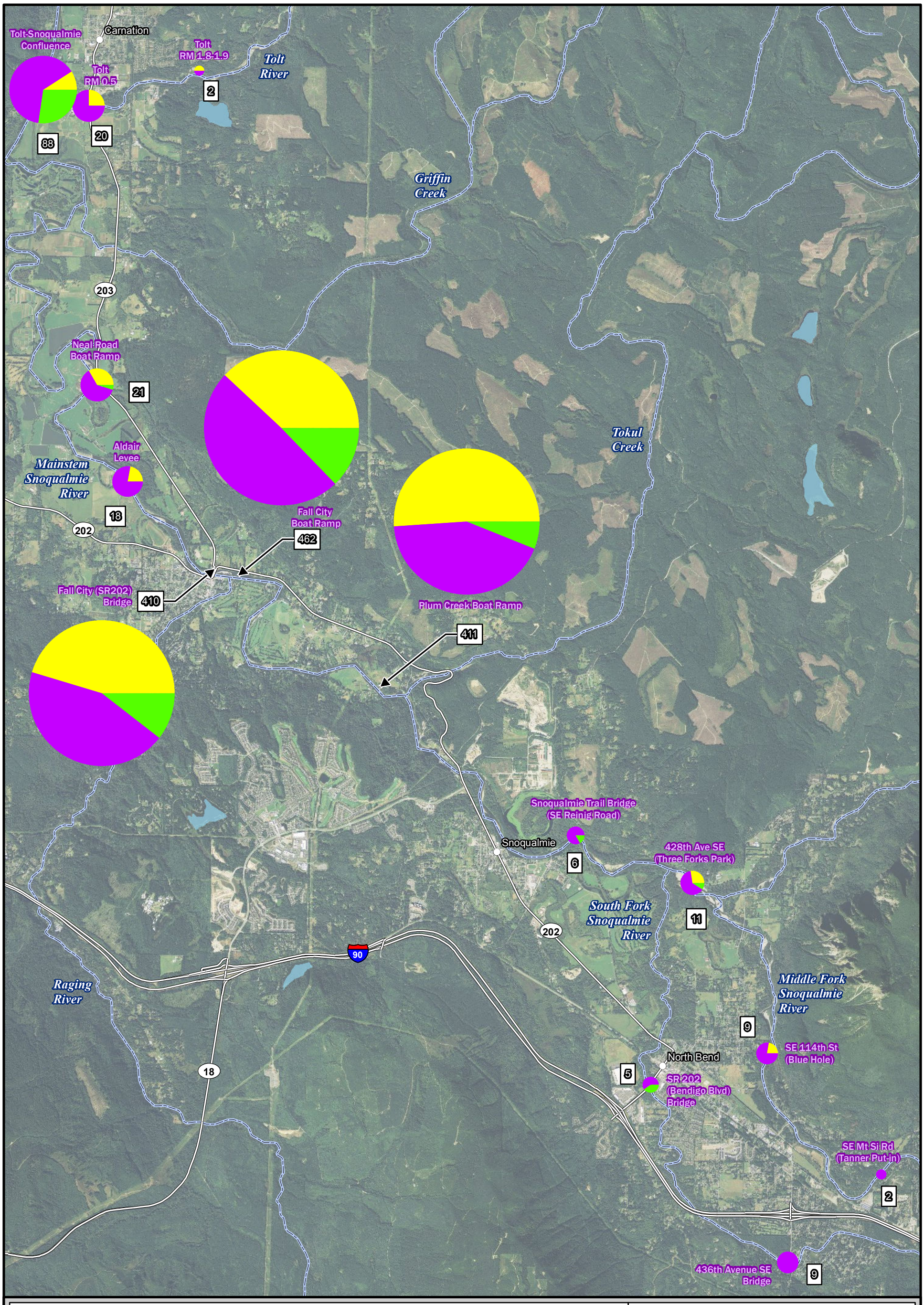


Figure D-19. Vessels Observed with Paddles by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.



Legend

Did the group have coolers visible?

125

No

Unknown

Yes

City or town

Highway

River

Figure D-20. Percentage of Total Groups Observed with Coolers by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

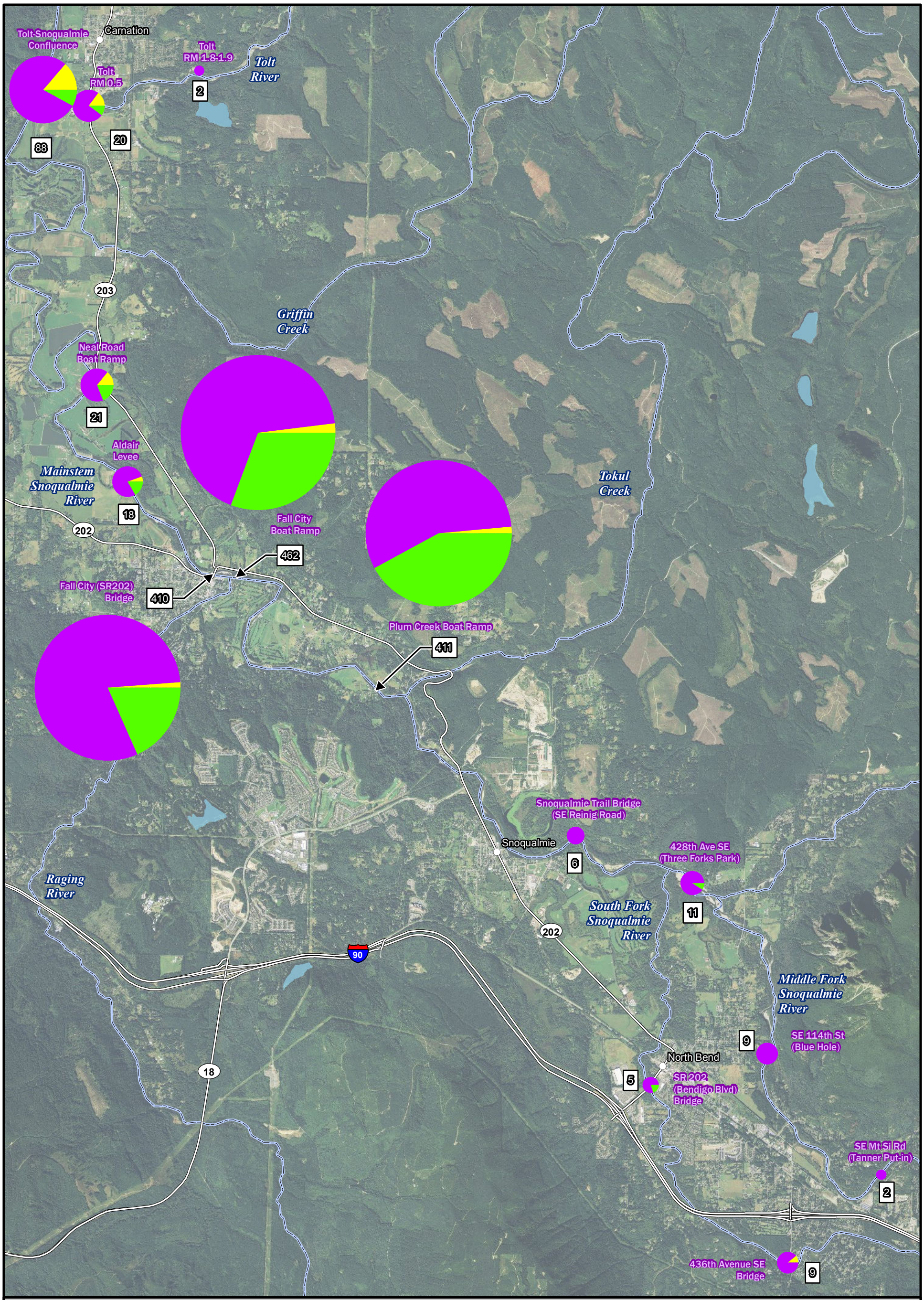
0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\coolers.mxd (10/7/2014)



Legend

Did the group have fishing equipment visible?

125

No

Unknown

Yes

City or town

Highway

River

Figure D-21. Percentage of Total Groups Observed with Fishing Gear by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

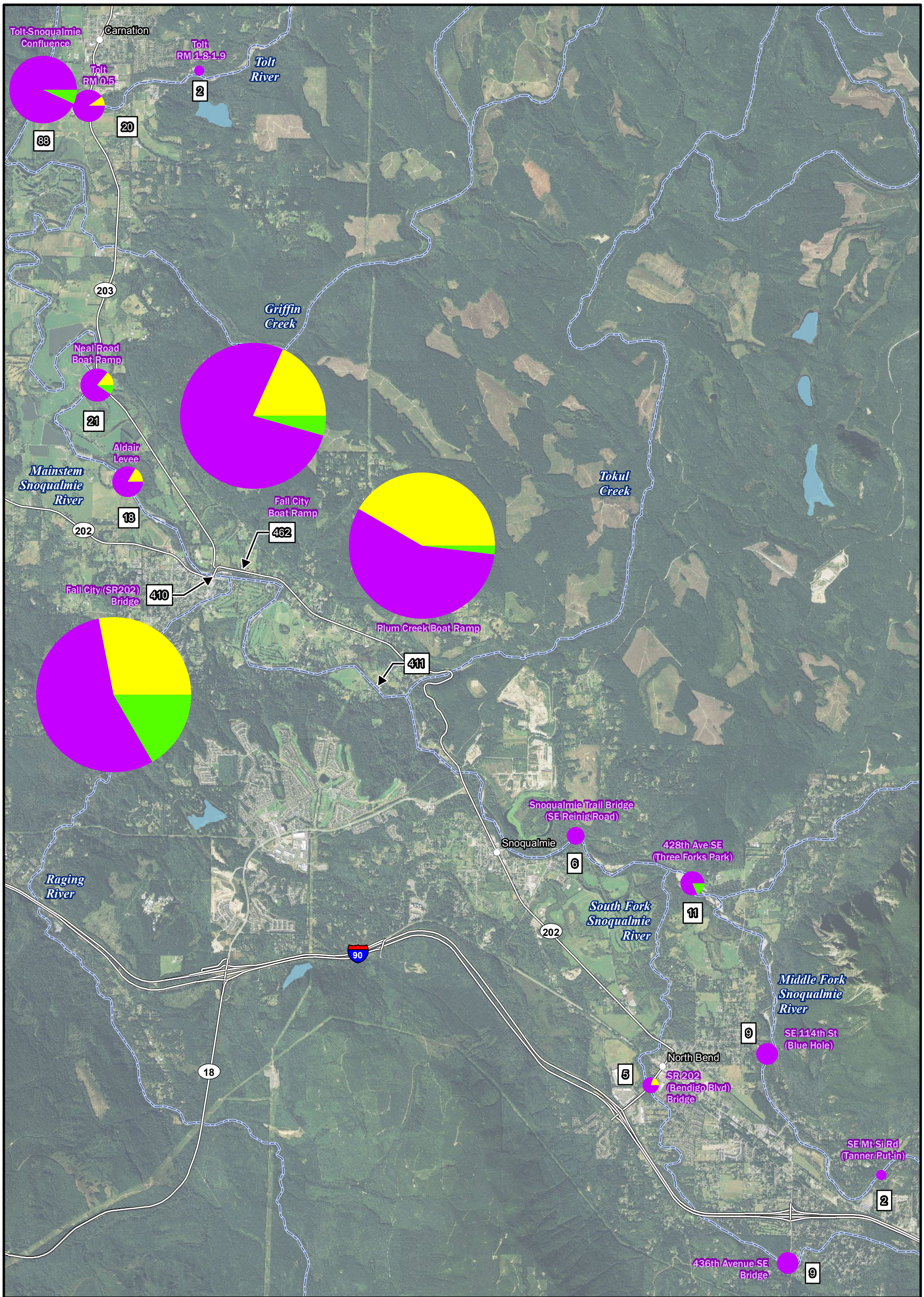
0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\fishing_equipment.mxd (10/7/2014)



Legend

Did the group have alcohol visible?

125

No

Unknown

Yes

City or town

Highway

River

Figure D-22. Percentage of Total Groups Observed with Alcohol by Observation Site for the King County Synthesis of 2013 River Recreation Studies, King County, Washington.

N

0 2,500 5,000 10,000 Feet

King County

Aerial: USDA (2011)

Prepared for King County by Herrera

K:\Projects\Y2010\10-04766-040\Project\Field_Observation\alcohol.mxd (10/7/2014)

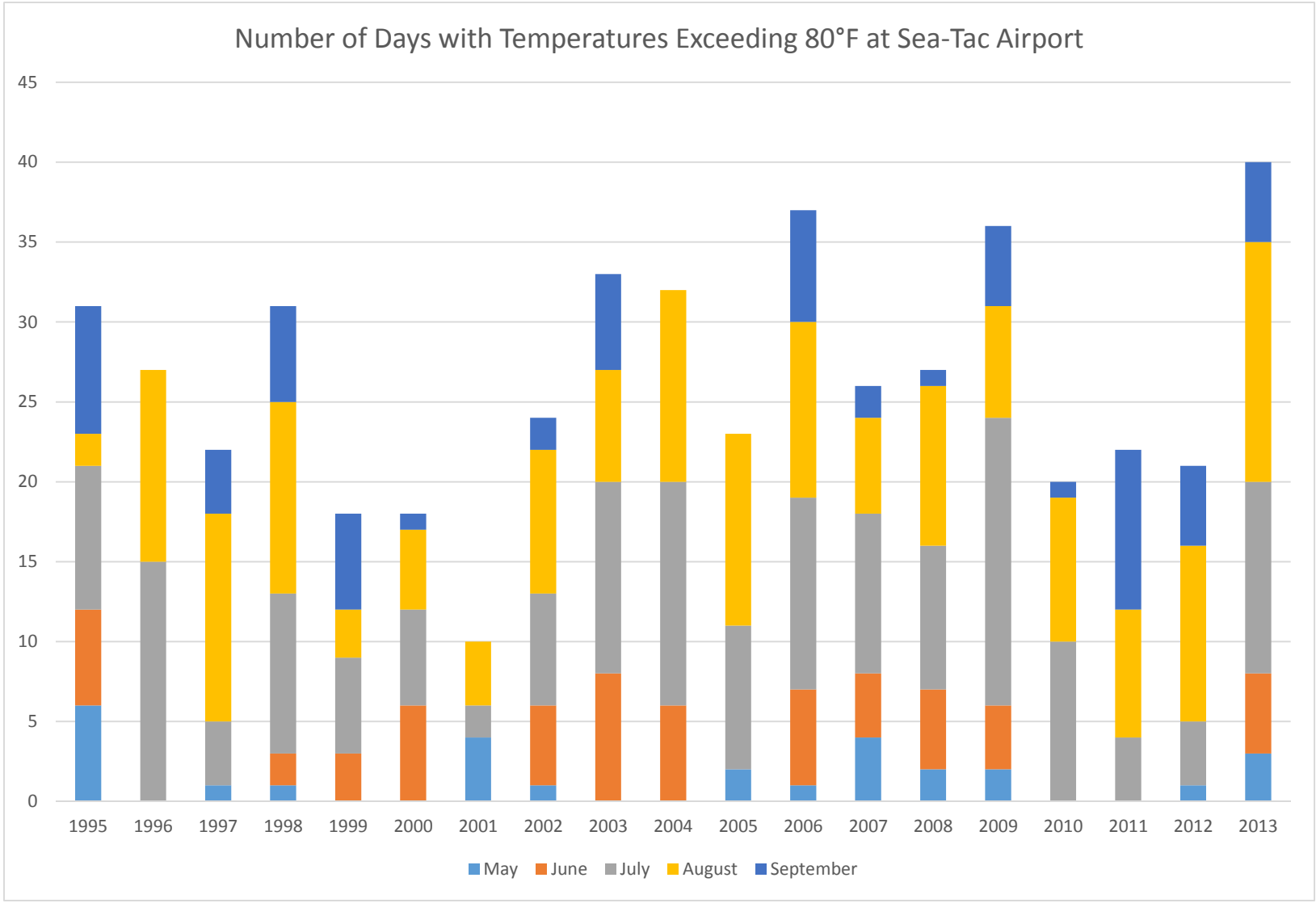


Figure D-23. Number of Warm Days in May–September of 1995–2013. Synthesis of 2013 River Recreation Studies.

APPENDIX E

Statistical Analysis

Statistical Analyses Performed

A two-sample exact Poisson test was applied to the Snoqualmie River field observation data and remote camera observation data to evaluate the following null (Ho) and alternate (Ha) hypotheses:

Ho: The number of groups observed early (11:00 AM to 3:00 PM) and late (3:00 PM to 7:00 PM) in the day is the same.

Ha: The number of groups observed early (11:00 AM to 3:00 PM) and late (3:00 PM to 7:00 PM) in the day is different.

Ho: The number of people observed early (11:00 AM to 3:00 PM) and late (3:00 PM to 7:00 PM) in the day is the same.

Ha: The number of people observed early (11:00 AM to 3:00 PM) and late (3:00 PM to 7:00 PM) in the day is different.

Ho: The number of groups observed on weekdays and weekends is the same.

Ha: The number of groups observed on weekdays and weekends is different.

Ho: The number of people observed on weekdays and weekends is the same.

Ha: The number of people observed on weekdays and weekends is different.

Ho: The number of groups observed during the peak (July 4 to September 2) and off-peak days of the summer is the same.

Ha: The number of groups observed during the peak (July 4 to September 2) and off-peak days of the summer is different.

Ho: The number of people observed during the peak (July 4 to September 2) and off-peak days of the summer is the same.

Ha: The number of people observed during the peak (July 4 to September 2) and off-peak days of the summer is different.

These tests were performed on the data from each individual site, pooled data from all sites on the Snoqualmie River above and below Snoqualmie Falls, and pooled data from all sites on the Snoqualmie River. In all cases, statistical significant was evaluated based on alpha (α) level of 0.05.

A chi-square test was also applied to the Snoqualmie River field observation data to evaluate the following null and alternate hypotheses:

Ho: There is no relationship between the presence of life vests and children in a group.

Ha: There is relationship between the presence of life vests and children in a group.

Ho: There is no relationship between the presence of alcohol and children in a group.

Ha: There is relationship between the presence of alcohol and children in a group.

Ho: There is no relationship between the presence of coolers and children in a group.

Ha: There is relationship between the presence of coolers and children in a group.

Ho: There is no relationship between the presence of alcohol and youth in a group.

Ha: There is relationship between the presence of alcohol and youth in a group.

Ho: There is no relationship between the presence of coolers and youth in a group.

Ha: There is relationship between the presence of coolers and youth in a group.

These tests were also performed on the data from each individual site, pooled data from all sites on the Snoqualmie River above and below Snoqualmie Falls, and pooled data from all sites on the Snoqualmie River. Statistical significant was evaluated based on alpha (α) level of 0.05.

A Kendall's tau correlation test was applied to the remote camera observation data to evaluate the following null and alternate hypotheses:

Ho: There is no relationship between the average number of groups observed across all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of groups observed across all sites and the maximum daily temperature on a given day.

Ho: There is no relationship between the average number of people observed across all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of people observed across all sites and the maximum daily temperature on a given day.

Ho: There is no relationship between the average number of groups observed on weekdays across all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of groups observed on weekdays across all sites and the maximum daily temperature on a given day.

Ho: There is no relationship between the average number of people observed across on weekdays all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of people observed across all sites on weekdays and the maximum daily temperature on a given day.

Ho: There is no relationship between the average number of groups observed on weekends across all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of groups observed on weekends across all sites and the maximum daily temperature on a given day.

Ho: There is no relationship between the average number of people observed across on weekends all sites and the maximum daily temperature on a given day.

Ha: There is a relationship between the average number of people observed across all sites on weekends and the maximum daily temperature on a given day.

Statistical significant in these correlation analyses was valuated based on alpha (α) level of 0.05.

In addition to the tests described above, exploratory regression analyses were performed using the remote camera data to identify key variables for predicting recreational river use. These analyses specifically involved the use of step-wise linear regression to determine if one or more of the following independent variables had a significant influence ($\alpha = 0.05$) on the number of people and number of groups that were observed at the remote camera locations: maximum daily temperature, weekend or weekday, and average daily river flow rate. Data for average daily river flow rate for each remote camera location were obtained from the closest USGS river gauge that was active during the study period. The specific gauges used in these analyses included:

- Gauge 12144500 on the Snoqualmie River
- Gauge 12100490 on the White River
- Gauge 12113000 on the Green River near Auburn
- Gauge 12113344 on the Green River near Kent
- Gauge 12119000 on the Cedar River

With three independent variables, there are eight possible models that could be developed using subsets of these variables. The best model was selected based on the Akaike Information Criterion (AIC) which is a goodness of fit measure that favors smaller residual error while minimizing the number of variables in the model (Bauman and Anderson 2002).

Reference

Burnham, K.P. and D.R. Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. New York, Springer. 2nd ed., XXVI, 488 p.

Table E1. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed Early (11 am to 3 pm) and Late (3 pm to 7 pm) in the Day Based on Snoqualmie River Field Observation Data.

	Number of Groups			Number of People		
Site	**Early (11 am - 3 pm)**	**Late (3 pm - 7 pm)**	**p-value**	**Early (11 am - 3 pm)**	**Late (3 pm - 7 pm)**	**p-value**
436th Street Bridge			1.000			1.000
Aldair Levee			0.077			0.154
Blue Hole			0.180			0.118
Fall City (SR202 Bridge)		+	**< 0.001**		+	**< 0.001**
Fall City (Zurfleuh) Boat Ramp		+	**< 0.001**		+	**< 0.001**
Gardner-Weeks Memorial Park			0.375	+		**0.039**
Neal Road Take-Out			0.664			0.053
Plum Creek Boat Ramp	+		**0.002**	+		**< 0.001**
Snoqualmie Trail Bridge			0.125		+	**0.008**
Tanner Put-In			1.000			0.508
Three Forks Park			0.549	+		**0.005**
Tolt RM 0.5 RB Bar		+	**0.039**		+	**< 0.001**
Tolt RM 1.8 to 1.9			1.000			0.688
Tolt-Snoqualmie Confluence			0.241			0.696
Above Falls			1.000			0.092
Below Falls		+	**< 0.001**		+	**< 0.001**
All Sites		+	**< 0.001**		+	**< 0.001**

Notes:

Bold p-values indicate statistically significant differences at an alpha (α) level of 0.05.

"+" indicates time of day with significantly more groups or people

Table E2. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed Early (11 am to 3 pm) and Late (3 pm to 7 pm) in the Day Based on Remote Camera Observation Data.

Site	Number of Groups			Number of People		
	Early (11 am - 3 pm)	Late (3 pm - 7 pm)	p-value	Early (11 am - 3 pm)	Late (3 pm - 7 pm)	p-value
KC1 - Ricardi North		+	**< 0.001**		+	**< 0.001**
KC2 - Elliot		+	**< 0.001**		+	**< 0.001**
KC3 - Fall City Park North			0.614			0.423
KC4 - Ricardi South		+	**< 0.001**		+	**< 0.001**
KC5 - Regis		+	**< 0.001**		+	**< 0.001**
KC6 - Briscoe North			0.832			0.766
KC7 - Briscoe South			0.267			0.405
KC8 - Fenster South		+	**< 0.001**		+	**< 0.001**
KC9 - Fenster North		+	**< 0.001**		+	**< 0.001**
KC10 - Van Doren			0.093			0.220
KC11 - Isaac Evans North		+	**< 0.001**		+	**< 0.001**
KC12 - Isaac Evans South		+	**< 0.001**		+	**< 0.001**
KC13 - Russel Woods			0.678			0.551
KC14 - White South			1.000			0.267
KC15 - White North			0.289			0.629
KC16 - Cherry Stand East		+	**< 0.001**		+	**< 0.001**
KC17 - Fall City Park South			0.695			0.242
KC18 - Cherry Stand West		+	**< 0.001**		+	**< 0.001**
KC19 - Auburn Black Diamond		+	**< 0.001**		+	**< 0.001**
KC20 - Whitney Bridge Upstream		+	**< 0.001**		+	**< 0.001**
KC21 - Whitney Bridge Downstream		+	**< 0.001**		+	**< 0.001**
ALL CAMERAS		+	**< 0.001**		+	**< 0.001**

Notes:

Bold p-values indicate statistically significant differences at an alpha (a) level of 0.05

"+" indicates time of day with significantly more groups or people

Table E3. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed on Weekdays and Weekends Based on Snoqualmie River Field Observation Data.

Site	Number of Groups			Number of People		
	Weekday	Weekend	p-value	Weekday	Weekend	p-value
436th Street Bridge			1.000			0.204
Aldair Levee			1.000			0.546
Blue Hole			1.000			0.607
Fall City (SR202 Bridge)		+	**< 0.001**		+	**< 0.001**
Fall City (Zurfleuh) Boat Ramp		+	**< 0.001**		+	**< 0.001**
Gardner-Weeks Memorial Park			0.604	+		**0.014**
Neal Road Take-Out		+	**0.020**		+	**0.041**
Plum Creek Boat Ramp			0.135		+	**< 0.001**
Snoqualmie Trail Bridge			0.688			1.000
Tanner Put-In			1.000			0.508
Three Forks Park			0.365	+		**< 0.001**
Tolt RM 0.5 RB Bar		+	**0.037**		+	**< 0.001**
Tolt RM 1.8 to 1.9			1.000			0.688
Tolt-Snoqualmie Confluence		+	**< 0.001**		+	**< 0.001**
Above Falls			0.635			0.166
Below Falls		+	**< 0.001**		+	**< 0.001**
All Sites		+	**< 0.001**		+	**< 0.001**

Notes:

Bold p-values indicate statistically significant differences at an alpha (a) level of 0.05.

"+" indicates time of week with significantly more groups or people

Table E4. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed on Weekdays and Weekends Based on Remote Camera Observation Data.

Sites	Number of Groups			Number of People		
	Weekday	Weekend	p-value	Weekday	Weekend	p-value
KC1 - Ricardi North		+	**< 0.001**		+	**< 0.001**
KC2 - Elliot		+	**< 0.001**		+	**< 0.001**
KC3 - Fall City Park North		+	**< 0.001**		+	**< 0.001**
KC4 - Ricardi South		+	**< 0.001**		+	**< 0.001**
KC5 - Regis			0.175			0.319
KC6 - Briscoe North			1.000			0.542
KC7 - Briscoe South			1.000			0.406
KC8 - Fenster South		+	**0.003**		+	**< 0.001**
KC9 - Fenster North		+	**0.007**		+	**< 0.001**
KC10 - Van Doren			0.531			0.890
KC11 - Isaac Evans North		+	**< 0.001**		+	**< 0.001**
KC12 - Isaac Evans South			0.520		+	**< 0.001**
KC13 - Russel Woods			0.682			1.000
KC14 - White South			1.000			1.000
KC15 - White North			0.489			0.463
KC16 - Cherry Stand East		+	**< 0.001**		+	**< 0.001**
KC17 - Fall City Park South		+	**0.004**		+	**< 0.001**
KC18 - Cherry Stand West		+	**< 0.001**		+	**< 0.001**
KC19 - Auburn Black Diamond		+	**0.005**		+	**< 0.001**
KC20 - Whitney Bridge Upstream		+	**< 0.001**		+	**< 0.001**
KC21 - Whitney Bridge Downstream		+	**< 0.001**		+	**< 0.001**
ALL CAMERAS		+	**< 0.001**		+	**< 0.001**

Notes:

Bold p-values indicate statistically significant differences at an alpha (a) level of 0.05

"+" indicates time of week with significantly more groups or people

Table E5. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed During the Peak (July 4 to September 2 and Off-Peak Days of the Summer Based on Snoqualmie River Field Observation Data.

	Number of Groups			Number of People		
Sites	**Peak**	**Off Peak**	**p-value**	**Peak**	**Off Peak**	**p-value**
436th Street Bridge			NA			NA
Aldair Levee			0.341			0.053
Blue Hole			0.727			0.786
Fall City (SR202 Bridge)			0.369	+		**< 0.001**
Fall City (Zurfleuh) Boat Ramp			0.206	+		**< 0.001**
Gardner-Weeks Memorial Park			1.000			0.742
Neal Road Take-Out			NA			NA
Plum Creek Boat Ramp	+		**< 0.001**	+		**< 0.001**
Snoqualmie Trail Bridge			NA			NA
Tanner Put-In			1.000			0.508
Three Forks Park			NA			NA
Tolt RM 0.5 RB Bar			0.107		+	**0.005**
Tolt RM 1.8 to 1.9			1.000			0.688
Tolt-Snoqualmie Confluence			0.519		+	**0.004**
Above Falls			0.393	+		**0.044**
Below Falls			0.931	+		**< 0.001**
All Sites		+	**< 0.001**			0.798

Notes:

Bold p-values indicate statistically significant differences at an alpha (a) level of 0.05.

"+" indicates time of season with significantly more groups or people

NA: insufficient number of observations in one or more group to perform analysis.

Table E6. Results from Two-Sample Exact Poisson Test Comparing Numbers of Groups and People Observed During the Peak (July 4 to September 2) and Off-Peak Days of the Summer Based on Remote Camera Observation Data.

Sites	Number of Groups			Number of People		
	Peak	Off Peak	p-value	Peak	Off Peak	p-value
KC1 - Ricardi North	+		**0.003**	+		**< 0.001**
KC2 - Elliot	+		**0.028**			0.221
KC3 - Fall City Park North			0.450	+		**0.011**
KC4 - Ricardi South			0.074	+		**0.009**
KC5 - Regis		+	**0.009**		+	**< 0.001**
KC6 - Briscoe North			1.000			0.838
KC7 - Briscoe South			0.503			0.802
KC8 - Fenster South			0.187			0.547
KC9 - Fenster North			0.619			0.439
KC10 - Van Doren			1.000			0.402
KC11 - Isaac Evans North			1.000			0.053
KC12 - Isaac Evans South	+		**0.003**	+		**< 0.001**
KC13 - Russel Woods			1.000			0.651
KC14 - White South			1.000			1.000
KC15 - White North			1.000			0.224
KC16 - Cherry Stand East	+		**< 0.001**	+		**< 0.001**
KC17 - Fall City Park South	+		**0.003**	+		**< 0.001**
KC18 - Cherry Stand West	+		**< 0.001**	+		**< 0.001**
KC19 - Auburn Black Diamond		+	**0.020**		+	**0.008**
KC20 - Whitney Bridge Upstream	+		**< 0.001**	+		**< 0.001**
KC21 - Whitney Bridge Downstream	+		**0.049**	+		**0.021**
ALL CAMERAS	+		**< 0.001**	+		**< 0.001**

Notes:

Bold p-values indicate statistically significant differences at an alpha (a) level of 0.05

"+" indicates time of season with significantly more groups or people

Table E7. Results from a Chi-Square Test to Evaluate Relationships Between the Presence of Life Vests and Children in a Group.

	Chi-Square Test Statistic	p-value
436th Street Bridge		NA
Aldair Levee		NA
Blue Hole		NA
Fall City (SR202 Bridge)	65.3	**< 0.001**
Fall City (Zurfleuh) Boat Ramp	32.7	**< 0.001**
Gardner-Weeks Memorial Park	0.1	0.819
Neal Road Take-Out		NA
Plum Creek Boat Ramp	82.4	**< 0.001**
Snoqualmie Trail Bridge		NA
Tanner Put-In	0.0	1.000
Three Forks Park	1.1	0.300
Tolt RM 0.5 RB Bar	0.6	0.432
Tolt RM 1.8 to 1.9		NA
Tolt-Snoqualmie Confluence	0.1	0.781
Above Falls	2.9	0.088
Below Falls	159.9	**< 0.001**
All Sites	165.1	**< 0.001**

Notes:

Bold p-values indicate statistically significant relationship is present at an alpha (a) level of 0.05.

All sites with statistically significant Chi-Square test statistics showed a positive relationship between presence of children and life vests

NA: insufficient number of observations in one or more group to perform analysis.

Table E8. Results from a Chi-Square Test to Evaluate Relationships Between the Presence of Alcohol/Coolers and Children/Youths in a Group.

	Children and Alcohol		Youth and Alcohol		Children and Coolers		Youth and Coolers	
	Chi-Squared Statistic	**p-value**	**Chi-Squared Statistic**	**p-value**	**Chi-Squared Statistic**	**p-value**	**Chi-Squared Statistic**	**p-value**
436th Street Bridge		NA		NA		NA		NA
Aldair Levee		NA	0.1	0.800		NA	0.3	0.596
Blue Hole		NA		NA		NA	0.0	1.000
Fall City (SR202 Bridge)	0.9	0.340	3.8	0.052	1.1	0.301	0.0	1.000
Fall City (Zurfleuh) Boat Ramp	0.3	0.598	12.7	**< 0.001**	0.0	0.845	6.6	**0.010**
Gardner-Weeks Memorial Park	0.0	1.000	0.0	1.000		NA		NA
Neal Road Take-Out		NA	0.0	0.964		NA	0.0	1.000
Plum Creek Boat Ramp	10.9	**< 0.001**	9.5	**0.002**	0.6	0.448	1.2	0.274
Snoqualmie Trail Bridge		NA		NA		NA		NA
Tanner Put-In		NA		NA		NA		NA
Three Forks Park		NA		NA	0.8	0.366	1.0	0.324
Tolt RM 0.5 RB Bar		NA	0.0	1.000	0.6	0.436	0.1	0.787
Tolt RM 1.8 to 1.9		NA		NA		NA	0.0	1.000
Tolt-Snoqualmie Confluence		NA		NA	0.0	0.834	0.0	0.842
Above Falls	0.0	1.000	0.0	1.000	1.4	0.232	0.1	0.701
Below Falls	13.1	**< 0.001**	32.6	**< 0.001**	0.6	0.451	12.3	**< 0.001**
All Sites	13.5	**< 0.001**	37.0	**< 0.001**	2.0	0.163	0.0	0.966

Notes:

Bold p-values indicate statistically significant relationship is present at an alpha (a) level of 0.05.

All sites with statistically significant Chi-Square test statistics showed a negative relationship between presence of children/youths and alcohol/coolers

NA: insufficient number of observations in one or more group to perform analysis.

Table E9. Results from a Kendall's Tau Correlation Test to Evaluate Relationships Between the Average Number of Groups/People Observed Across All Sites from Remote Camera Observation Data and the Maximum Daily Temperature on a Given Day.

	Kendall Tau	p-value
ALL		
Groups/Site	0.42	**<0.001**
People/Site	0.41	**<0.001**
WEEKDAY		
Groups/Site	0.6	**<0.001**
People/Site	0.6	**<0.001**
WEEKEND		
Groups/Site	0.47	**0.001**
People/Site	0.39	**0.009**

Notes:

Bold p-values indicate statistically significant relationship is present at an alpha (a) level of 0.05.

Table E10. Results from Multiple Regression Analyses to Develop Models for Predicting Average Number of People at Each Remote Camera Observation Location.

	Regression Models for Predicting Number of People				
	Camera	Intercept	Temp	Weekend	Flow
1	KC1 - Ricardi North	x	x	x	
2	KC10 - Van Doren	x			
3	KC11 - Isaac Evans North	x	x	x	
4	KC12 - Isaac Evans South	x	x	x	x
5	KC13 - Russel Woods	x		x	
6	KC14 - White South				
7	KC15 - White North	x	x	x	
8	KC16 - Cherry Stand East	x	x	x	x
9	KC17 - Fall City Park South	x	x	x	x
10	KC18 - Cherry Stand West	x	x	x	x
11	KC19 - Auburn Black Diamond	x		x	
12	KC2 - Elliot	x	x	x	x
13	KC20 - Whitney Bridge Upstream	x	x	x	x
14	KC21 - Whitney Bridge Downstream	x	x	x	
15	KC22 - Raindow Bend	x			
16	KC23 - Belmondo	x	x		
17	KC3 - Fall City Park North	x	x	x	
18	KC4 - Ricardi South	x	x	x	x
19	KC5 - Regis	x	x	x	
20	KC6 - Briscoe North	x			
21	KC7 - Briscoe South	x			
22	KC8 - Fenster South	x	x	x	
23	KC9 - Fenster North	x	x	x	

		Intercept		Temp			Weekend			Flow			R-sq	Adj R-sq	F-sta	Model p-value
	Camera	Coef	p-value	Coef	Standardized Coef	p-value	Coef	Standardized Coef	p-value	Coef	Standardized Coef	p-value				
1	KC1 - Ricardi North	-89.74	**0.002**	1.27	0.41	**< 0.001**	20.92	0.53	**< 0.001**				0.40	0.37	16.22	**< 0.001**
2	KC10 - Van Doren	3.18	**< 0.001**										0.00	0.00		
3	KC11 - Isaac Evans North	-38.28	**0.013**	0.55	0.36	**0.005**	9.72	0.58	**< 0.001**				0.38	0.35	13.57	**< 0.001**
4	KC12 - Isaac Evans South	-34.62	0.301	1.10	0.60	**< 0.001**	13.32	0.71	**< 0.001**	-0.15	-0.33	**0.030**	0.45	0.39	8.17	**< 0.001**
5	KC13 - Russel Woods	1.57	**< 0.001**				0.71	0.52	0.080				0.20	0.15	3.57	0.080
6	KC14 - White South		**< 0.001**													
7	KC15 - White North	-116.98	**0.005**	1.50	1.04	**0.005**	3.70	0.55	**0.018**				0.99	0.98	109.31	**0.009**
8	KC16 - Cherry Stand East	-808.96	**< 0.001**	10.66	0.40	**< 0.001**	256.61	0.63	**< 0.001**	0.08	0.27	**< 0.001**	0.57	0.55	34.31	**< 0.001**
9	KC17 - Fall City Park South	-32.24	**0.016**	0.38	0.32	**0.017**	7.94	0.46	**< 0.001**	0.01	0.29	**0.029**	0.34	0.30	7.02	**< 0.001**
10	KC18 - Cherry Stand West	-655.12	**< 0.001**	8.96	0.34	**< 0.001**	256.27	0.63	**< 0.001**	0.05	0.19	**0.016**	0.55	0.53	31.62	**< 0.001**
11	KC19 - Auburn Black Diamond	4.50	**< 0.001**				4.06	0.36	**0.039**				0.15	0.12	4.73	**0.039**
12	KC2 - Elliot	-118.31	**< 0.001**	1.52	0.47	**< 0.001**	22.91	0.54	**< 0.001**	0.05	0.20	**0.038**	0.49	0.47	19.16	**< 0.001**
13	KC20 - Whitney Bridge Upstream	22.85	0.788	2.16	0.39	**0.005**	42.86	0.58	**< 0.001**	-0.56	-0.39	**0.007**	0.44	0.39	9.04	**< 0.001**
14	KC21 - Whitney Bridge Downstrea	-137.21	**0.006**	1.95	0.43	**0.002**	26.72	0.50	**< 0.001**				0.32	0.29	9.81	**< 0.001**
15	KC22 - Raindow Bend	2.74	**< 0.001**										0.00	0.00		
16	KC23 - Belmondo	-31.48	**0.016**	0.46	0.67	**0.007**							0.36	0.32	9.47	**0.007**
17	KC3 - Fall City Park North	-31.91	**0.024**	0.51	0.34	**0.005**	10.56	0.47	**< 0.001**				0.35	0.32	11.50	**< 0.001**
18	KC4 - Ricardi South	-99.72	**< 0.001**	1.23	0.40	**< 0.001**	19.03	0.49	**< 0.001**	0.06	0.25	**0.017**	0.42	0.39	13.76	**< 0.001**
19	KC5 - Regis	-58.35	**0.002**	0.78	0.58	**< 0.001**	3.10	0.20	0.172				0.33	0.28	7.09	**0.003**
20	KC6 - Briscoe North	3.46	**0.001**										0.00	0.00		
21	KC7 - Briscoe South	1.94	**< 0.001**										0.00	0.00		
22	KC8 - Fenster South	-56.46	0.057	0.86	0.32	**0.019**	12.55	0.43	**0.002**				0.25	0.21	7.26	**0.002**
23	KC9 - Fenster North	-56.70	0.064	0.86	0.31	**0.023**	12.30	0.40	**0.004**				0.23	0.19	6.67	**0.003**

Notes:
Bold if p-value < 0.05

Table E11. Results from Multiple Regression Analyses to Develop Models for Predicting Average Number of Groups at Each Remote Camera Observation Location.

	Regression Models for Predicting Number of Groups				
	Camera	Intercept	Temp	Weekend	Flow
1	KC1 - Ricardi North	x	x	x	
2	KC10 - Van Doren	x			
3	KC11 - Isaac Evans North	x	x	x	
4	KC12 - Isaac Evans South	x	x	x	x
5	KC13 - Russel Woods	x			
6	KC14 - White South				
7	KC15 - White North	x	x	x	x
8	KC16 - Cherry Stand East	x	x	x	x
9	KC17 - Fall City Park South	x	x	x	x
10	KC18 - Cherry Stand West	x	x	x	x
11	KC19 - Auburn Black Diamond	x		x	x
12	KC2 - Elliot	x	x	x	x
13	KC20 - Whitney Bridge Upstream	x	x	x	x
14	KC21 - Whitney Bridge Downstream	x	x	x	
15	KC22 - Raindow Bend	x	x		
16	KC23 - Belmondo	x	x		x
17	KC3 - Fall City Park North	x	x	x	
18	KC4 - Ricardi South	x	x	x	x
19	KC5 - Regis	x	x	x	
20	KC6 - Briscoe North	x			
21	KC7 - Briscoe South	x		x	
22	KC8 - Fenster South	x	x	x	
23	KC9 - Fenster North	x	x	x	

		Intercept		Temp			Weekend			Flow			R-sq	Adj R-sq	F-sta	Model p-value
	Camera	Coef	p-value	Coef	Standardized Coef	p-value	Coef	Standardized Coef	p-value	Coef	Standardized Coef	p-value				
1	KC1 - Ricardi North	-32.44	**0.003**	0.46	0.40	**< 0.001**	7.61	0.52	**< 0.001**				0.38	0.35	14.72	**< 0.001**
2	KC10 - Van Doren	1.35	**< 0.001**										0.00	0.00		
3	KC11 - Isaac Evans North	-13.86	**0.001**	0.20	0.48	**< 0.001**	2.26	0.51	**< 0.001**				0.39	0.36	14.20	**< 0.001**
4	KC12 - Isaac Evans South	-5.95	0.712	0.41	0.51	**0.008**	4.00	0.48	**0.014**	-0.08	-0.38	**0.025**	0.34	0.27	5.12	**0.006**
5	KC13 - Russel Woods	2.81	**0.002**										0.00	0.00		
6	KC14 - White South															
7	KC15 - White North	-43.54	**0.010**	0.54	1.07	**0.009**	2.25	0.92	**0.012**	0.00	0.36	**0.031**	1.00	1.00	1908.29	**0.017**
8	KC16 - Cherry Stand East	-208.29	**< 0.001**	2.85	0.47	**< 0.001**	55.31	0.60	**< 0.001**	0.01	0.23	**0.004**	0.57	0.56	34.71	**< 0.001**
9	KC17 - Fall City Park South	-8.07	0.100	0.11	0.26	0.072	2.41	0.40	**0.006**	0.00	0.24	0.093	0.24	0.19	4.31	**0.010**
10	KC18 - Cherry Stand West	-160.94	**< 0.001**	2.28	0.40	**< 0.001**	53.21	0.59	**< 0.001**	0.01	0.15	0.050	0.54	0.52	30.83	**< 0.001**
11	KC19 - Auburn Black Diamond	-6.33	0.282				1.60	0.34	0.097	0.03	0.29	0.145	0.22	0.16	3.75	**0.037**
12	KC2 - Elliot	-47.27	**< 0.001**	0.63	0.48	**< 0.001**	9.15	0.53	**< 0.001**	0.01	0.14	0.164	0.46	0.43	16.81	**< 0.001**
13	KC20 - Whitney Bridge Upstream	-6.96	0.791	0.70	0.42	**0.003**	11.53	0.53	**< 0.001**	-0.13	-0.32	**0.032**	0.39	0.34	7.49	**< 0.001**
14	KC21 - Whitney Bridge Downstrea	-49.99	**< 0.001**	0.70	0.50	**< 0.001**	8.31	0.54	**< 0.001**				0.39	0.36	13.30	**< 0.001**
15	KC22 - Raindow Bend	-0.54	0.665	0.02	0.24	0.148							0.10	0.05	2.26	0.148
16	KC23 - Belmondo	-11.56	**0.008**	0.15	0.71	**0.003**				0.00	0.32	**0.144**	0.43	0.36	6.16	**0.010**
17	KC3 - Fall City Park North	-10.15	**0.015**	0.17	0.39	**0.002**	3.03	0.45	**< 0.001**				0.37	0.34	12.44	**< 0.001**
18	KC4 - Ricardi South	-32.14	**0.001**	0.39	0.35	**0.002**	6.55	0.46	**< 0.001**	0.03	0.28	**0.009**	0.39	0.35	11.78	**< 0.001**
19	KC5 - Regis	-16.83	**0.003**	0.23	0.57	**< 0.001**	1.43	0.32	**0.036**				0.35	0.30	7.65	**0.002**
20	KC6 - Briscoe North	1.69	**< 0.001**										0.00	0.00		
21	KC7 - Briscoe South	3.00	**< 0.001**				-1.00	-1.42	**0.151**				0.27	0.17	2.59	
22	KC8 - Fenster South	-22.42	**0.016**	0.33	0.40	**0.004**	2.67	0.29	**0.032**				0.22	0.19	6.26	**0.004**
23	KC9 - Fenster North	-17.77	**0.017**	0.27	0.40	**0.004**	2.21	0.30	**0.026**				0.22	0.19	6.51	**0.003**

Notes:
Bold if p-value < 0.05

Estimate of Number of Floaters on King County Rivers over Study Period

Methods

Estimates of the total number of users on each of the following rivers were derived based on data obtained from remote field camera observations: Cedar River, Green River, White River, and Snoqualmie River. The remote field cameras captured the total number of recreational river users present each day between 11:00 AM and 7:00 PM over a period that generally extended from late June through mid-September 2013. For this analysis, estimates of the total number users on each river were derived for the peak period of river use that extended from July 4 through September 2, 2013.

A total of 23 remote field cameras were installed across the five rivers identified above. To obtain estimates of the total number of users on each river, a subset of these cameras were selected for use in this analysis based on the following considerations:

- The camera with the most complete data and best view of the river was selected where multiple cameras were co-located on the same river reach.
- To avoid double counting river users, observations from a single camera were taken to represent a river reach between known put-ins and take-outs.
- Where put-in and take-out locations were uncertain, cameras were selected to achieve a minimum distance of 2 miles between each camera on a river reach.

Table E12 lists the cameras selected to cumulatively estimate the number of users on each river.

Table E12. Remote Field Cameras Used To Represent River Reach in Total User Count Estimate.

River	Cameras
Cedar River	Ricardi North
	Regis
	Belmondo
	Rainbow Bend
Green River	Whitney Bridge Up
	Auburn Black Diamond
	Fenster South
	Isaac Evans North
	Van Doren
	Briscoe South
White River	White North
Snoqualmie	Cherry Stand East

Remote field cameras at two of the sites had significant data gaps due to malfunctions and other operational issues: Belmondo and Van Doren. To fill these data gaps, linear regression models were developed for these sites to predict the average number of daily users as a function of maximum daily temperature and/or period of the week (i.e., weekend or week day). For the Belmondo site, both the maximum daily temperature and period of the week were used to predict the average number of daily users. However, for the Van Doren site, only maximum daily temperature was used for this purpose. Linear regression model coefficients and their associated p-values are documented in Table E13 for each site.

Table E13. Linear Regression Model Coefficients for Predicting Average Number of Daily Users.

Camera	Intercept	p-value	Max. Daily Temp. Slope Coefficient	p-value	Weekend/Weekday Slope Coefficient	p-value	Multiple R-Squared
Belmondo	-9.75	0.0005	0.14	0.0002	1.37	0.038	0.195
Van Doren	-4.38	0.0176	0.07	0.0060			0.0939

Results and Discussion

The estimated total number of recreational river users by river for the period from July 4, 2013, through September 2, 2013, are presented in Table E14. Also provided are the average number of users observed each day for weekends, weekdays, warm days (greater than or equal to 75°F), and cold days (less than 75°F). When interpreting these results, the following limitation should be noted:

- The remote cameras due not provide complete coverage across all reaches in each river; therefore, the actual number of users may be underestimated.
- There is no way to verify users are not being double counted if they float by multiple cameras used in this analysis; therefore, the actual number of users may be overestimated.

This analysis estimated 1,064 river users were present on the Cedar River between July 4 and September 2, 2013; or an average of 18 people per day. In comparison, the Cedar River Recreation Study (King County 2011) estimated 6,700 river users were present on the same river between May and September 2010; or an average of 44 people per day. The substantial differences between these estimates may be due to the following reasons:

- The Cedar River Study did not account for the likelihood of double counting floaters between observation points.
- The Cedar River Study evaluated river use farther upstream and downstream compared to this analysis, including additional put-in and take-out locations.

Table E14. Estimated Total Number of Users on Each River from July 4, 2013, Through September 2, 2013.						
	Total River Users[a]	**Average Users/Day**	**Average Users/ Weekend Day**	**Average Users/ Weekday**	**Average Users/ Warm Day (>= 75°)**	**Average Users/ Cool Day (< 75°)**
Cedar River	**1,064**					
Ricardi North	756	12	25	7	15	6
Regis	151	2	2	3	3	1
Belmondo[b]	109	2	3	1	2	1
Rainbow Bend	48	1	2	0	1	0
Green River	**2,360**					
Whitney Bridge Up	1,131	19	33	13	21	13
Auburn-Black Diamond	138	2	3	2	3	1
Fenster South	641	11	17	8	14	2
Isaac Evans North	368	6	12	3	7	3
Van Doren[b]	63	1	1	1	1	0
Briscoe South	19	0.3	0.2	0.3	0.4	0.1
White River	**16**					
White North	16	0.3	0.7	0.1	0.4	0.0
Snoqualmie	**11,198**					
Cherry Stand East	11,198	184	387	98	211	108

Notes:

[a] Total number of users based on field camera observations between July 4, 2013 and September 2, 2013.

[b] Gaps in observed data were filled with multiple regression estimates of users using daily maximum temperature and/or week day.

References

King County. 2011. Cedar River Recreation Study – Floating the Cedar River. Department of Natural Resources and Parks, Seattle, WA. November 2011.

APPENDIX F

Interview Results

INTERVIEW RESULTS

Table F-1. 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
1	**Please indicate how often you do the following types of river recreation?**		
	Boating		
	Average number of years on any river	5.5	
	Average number of years on this river	2.9	
	Average number of days/year on this river	4.2	
	Average number of days/year on any river	6.2	
	Canoeing/Kayaking		
	Average number of years on any river	0.3	
	Average number of years on this river	0	
	Average number of days/year on this river	5	
	Average number of days/year on any river	5	
	Floating/Tubing		
	Average number of years on any river	6.4	
	Average number of years on this river	5.75	
	Average number of days/year on this river	4.3	
	Average number of days/year on any river	5.5	
	Fishing		
	Average number of years on any river	4.2	
	Average number of years on this river	1	
	Average number of days/year on this river	5	
	Average number of days/year on any river	5	
	Swimming/Wading		
	Average number of years on any river	4.8	
	Average number of years on this river	2.2	
	Average number of days/year on this river	5.2	
	Average number of days/year on any river	6	

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
2	**Are there other river reaches you regularly float/boat?**		
	Yes	8	30.8%
	No	18	69.2%
	If yes, which?		
	Yakima	4	50.0%
	Skykomish	3	37.5%
	Bogachiel	1	12.5%
3	**How many people were in your boat/vessel today?**		
	Total People	54	
	Average Number of People per Vessel	2.5	
4	**How many people were in your group today?**		
	Total Adults (18+)	76	73.1%
	Average Number of Adults per Group	3.6	
	Total Youth (12-17)	25	24.0%
	Average Number of Youth per Group	8.3	
	Total Children (1 to 11)	3	2.9%
	Average Number of Children per Group	1.5	
5	**How many other boats/tubes were in your group today?**		
	Total Boats/Tubes	67	
	Average Boats/Tubes	3	
6	**What time did today did you put in and where?**		
	Time		
	11 to 1	4	15.4%
	1 to 3	10	38.5%
	3 to 5	6	23.1%
	5 to 7	0	0.0%
	No Response	6	23.1%
	Where		
	Near the Falls	5	19.2%
	Fall City Boat Launch	1	3.8%
	Hatchery	4	15.4%
	Plum River Boat Launch	5	19.2%
	Blue Hole	1	3.8%
	Other or Unknown	5	19.2%
	No Response	5	19.2%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
7	**About how many total hours did you spend on the river today per each of the following activities?**		
	Average hours		
	Rafting	2	
	Tubing	3.6	
	Boating	3.4	
	Floating	0	
	Kayaking	1	
	Unspecified Activity	4.3	
8	**Where do you live?**		
	98003	1	3.8%
	98004	1	3.8%
	98024	2	7.7%
	98027	2	7.7%
	98028	1	3.8%
	98033	1	3.8%
	98052	1	3.8%
	98053	3	11.5%
	98054	1	3.8%
	98077	1	3.8%
	98117	1	3.8%
	98122	1	3.8%
	98144	1	3.8%
	98406	1	3.8%
	Pierce County	1	3.8%
	No Response	7	26.9%
9	**Did you wear a PFD (life jacket) today?**		
	Yes	4	15.4%
	No	20	76.9%
	No Response	2	7.7%
	If no, please check any reason why you chose not to wear a PFD:		
	It's too hot	0	0.0%
	PFDs are uncomfortable	6	30.0%
	I'm a strong swimmer	7	35.0%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
	I'm a skilled boater	6	30.0%
	I don't have one	4	20.0%
	They are too expensive	1	5.0%
	The river is not hazardous at this flow	8	40.0%
	The river is not hazardous at all	3	15.0%
	Bring one/don't wear it	2	10.0%
	Forgot it	0	0.0%
10	**Please rate the ability of yourself and the least-skilled person in your group:**		
	Your boating/tubing ability		
	Novice or Beginner	0	0.0%
	Intermediate	12	46.2%
	Skilled	10	38.5%
	Expert or Highly Skilled	3	11.5%
	No Response	1	3.8%
	Your swimming ability		
	Novice or Beginner	0	0.0%
	Intermediate	7	26.9%
	Skilled	12	46.2%
	Expert or Highly Skilled	5	19.2%
	No Response	1	3.8%
	The group's least skilled boating/tubing ability		
	Novice or Beginner	6	23.1%
	Intermediate	12	46.2%
	Skilled	3	11.5%
	Expert or Highly Skilled	1	3.8%
	No Response	4	15.4%
	The group's least skilled swimming ability		
	Novice or Beginner	0	0.0%
	Intermediate	7	26.9%
	Skilled	12	46.2%
	Expert or Highly Skilled	5	19.2%
	No Response	2	7.7%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
11	**Prior to this trip, did you obtain information about river conditions (e.g., difficulty, flows, temperature, and potential hazards?**		
	Yes	5	
	No	18	
	No Response	3	
	If yes, please check any source who provided this information:		
	Friends or family (word of mouth)	1	20.0%
	A river guidebook	0	0.0%
	The King County Website	2	40.0%
	Another Internet Website	0	0.0%
	Other	2	40.0%
12	**Please rate your perception of the relative hazards you encountered today? (1 is less hazardous and 5 is more hazardous)**		
	Fast Water		
	1	15	57.7%
	2	3	11.5%
	3	0	0.0%
	4	0	0.0%
	5	1	3.8%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Cold Water		
	1	9	34.6%
	2	5	19.2%
	3	3	11.5%
	4	1	3.8%
	5	1	3.8%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Rocks in Rapids		
	1	13	50.0%
	2	5	19.2%
	3	0	0.0%
	4	1	3.8%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Deep Pools		
	1	9	34.6%
	2	8	30.8%
	3	2	7.7%
	4	0	0.0%
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Slippery or Undercut Access Points/Shore Areas		
	1	13	50.0%
	2	2	7.7%
	3	4	15.4%
	4	0	0.0%
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Fallen Trees in River		
	1	3	11.5%
	2	6	23.1%
	3	9	34.6%
	4	1	3.8%
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	6	23.1%
	Intoxication		
	1	14	53.8%
	2	2	7.7%
	3	2	7.7%
	4	0	0.0%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
	5	0	0.0%
	Don't Know	2	7.7%
	No Response	6	23.1%
	Other Users		
	1	14	53.8%
	2	3	11.5%
	3	0	0.0%
	4	0	0.0%
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	8	30.8%
	A Mix of the Hazards Listed Above		
	1	11	42.3%
	2	2	7.7%
	3	1	3.8%
	4	1	3.8%
	5	0	0.0%
	Don't Know	1	3.8%
	No Response	10	38.5%
13	**In general, do you support or oppose the following?**		
	Develop Website with Information About Hazards		
	Strongly oppose	0	0.0%
	Slightly oppose	1	3.8%
	Neutral	6	23.1%
	Slightly support	6	23.1%
	Strongly support	7	26.9%
	Don't know	0	0.0%
	No Response	6	23.1%
	Information Provided About Hazards via Social Media		
	Strongly oppose	0	0.0%
	Slightly oppose	3	11.5%
	Neutral	8	30.8%
	Slightly support	6	23.1%
	Strongly support	3	11.5%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
	Don't know	0	0.0%
	No Response	6	23.1%
	Increase Hazard Information at Put-Ins		
	Strongly oppose	1	3.8%
	Slightly oppose	1	3.8%
	Neutral	1	3.8%
	Slightly support	8	30.8%
	Strongly support	9	34.6%
	Don't know	0	0.0%
	No Response	6	23.1%
	On-River Warning Signs Upstream of Specific Hazards		
	Strongly oppose	2	7.7%
	Slightly oppose	0	0.0%
	Neutral	0	0.0%
	Slightly support	6	23.1%
	Strongly support	12	46.2%
	Don't know	0	0.0%
	No Response	6	23.1%
	On-River Direction Signs ("Go Left") for Specific Hazards		
	Strongly oppose	1	3.8%
	Slightly oppose	0	0.0%
	Neutral	0	0.0%
	Slightly support	7	26.9%
	Strongly support	11	42.3%
	Don't know	0	0.0%
	No Response	7	26.9%
	Require Boaters/Tubers to Wear Life Jackets (PFDs)		
	Strongly oppose	14	53.8%
	Slightly oppose	0	0.0%
	Neutral	4	15.4%
	Slightly support	1	3.8%
	Strongly support	1	3.8%
	Don't know	0	0.0%
	No Response	6	23.1%

Table F-1 (continued). 2013 Interview Results.			
Question Number	Question	Responses	
		Number of Responses	Percent of Total
	"No Alcohol" Regulations for All Boaters		
	Strongly oppose	17	65.4%
	Slightly oppose	1	3.8%
	Neutral	1	3.8%
	Slightly support	0	0.0%
	Strongly support	1	3.8%
	Don't know	0	0.0%
	No Response	6	23.1%
	Close River Segments at Flows that Increase Hazards		
	Strongly oppose	4	15.4%
	Slightly oppose	0	0.0%
	Neutral	5	19.2%
	Slightly support	7	26.9%
	Strongly support	3	11.5%
	Don't know	0	0.0%
	No Response	7	26.9%